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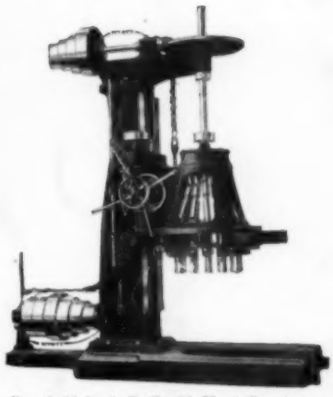

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(*See pages* 43, 44, 45, 46 *and* 47)

High Power Chain Drives

Editorial Correspondence

From the bicycle chain chain driving has developed to a point where 1000 *horsepower are transmitted in a single unit.*

It is characteristic of present-day progress when developments are taking place in so many directions that individual developments fail to attract general attention until they have reached a point which is fairly startling, a case in point being the use of silent chains for the transmission of large amounts of power. It is to the bicycle that thanks must be given for the impetus which led to the present developments in chain driving, bicycle chains having been the first in which high-class workmanship was adopted. Good chains having been made for bicycle use, other applications were naturally found for them, although naturally for moderate amounts of power. It is certainly a far cry from the bicycle chain to a drive which transmits 1000 horsepower and yet it is to this figure that chain driving has now come.

While these figures represent the maximum accomplishment, they do not include the only one which is noteworthy, there being in operation in this country not less than two hundred chain drives transmitting from 100 to 1000 horsepower each.

Our readers can scarcely fail to be interested in such a development, and we therefore give, through the courtesy of the Morse Chain Company, who are the makers of the installations, illustrations of a few of the more noteworthy cases.

Examples in Large Driving

Fig. 1, which, in its day, was a record breaker and which in length of service gives the most extensive experience in this work, represents two 200-horsepower drives which were installed in the mill of the Vulcanized Rubber Company, of Morrisville, Penn., in July, 1903, where they have since been in practically continuous ten-hour-a-day service. The first chain connects the engine shaft with the jack shaft, while the second one connects the jack shaft with the main shaft. The chains are identical except that the second one has three strands instead of two to offset its reduced speed, which is 700 feet per minute against 1152 on the first drive. The chains are of 1¼ inches pitch, each strand being 6 inches wide. The two sprockets of the first chain are of the same diameter and have 95 teeth each, the distance between centers being 84 inches, and the speed 97 revolutions. The second chain reduces the speed from 97 to 60 revolutions per minute, the sprockets having 59 and 95 teeth respectively.

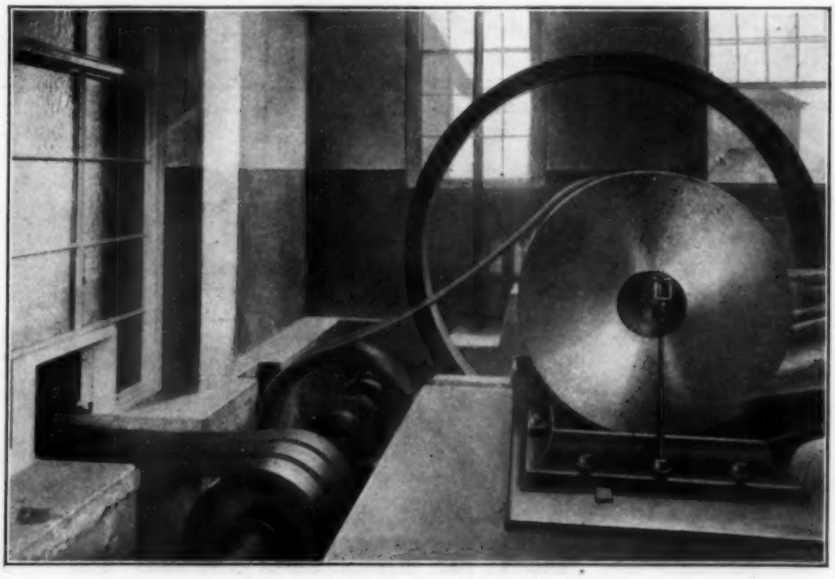


Fig. 1. Two 200-Horsepower Chain Drives

Fig. 2 shows one 350-horsepower and one 175-horsepower drive which, with another unit of the same description, has been running in the mill of the Peerless Rubber Company, at New Durham, N. J., since 1907. The chain on the 350-horsepower drive is 2 inches pitch, 15 inches face, and both sprockets have 111 teeth, the speed being 75 revolutions per minute, with a distance between centers of 150 inches, and a chain speed of 1387 feet per minute. The 175-horsepower drive runs to a second line shaft using sprockets having 95 teeth, at 75 revolu-

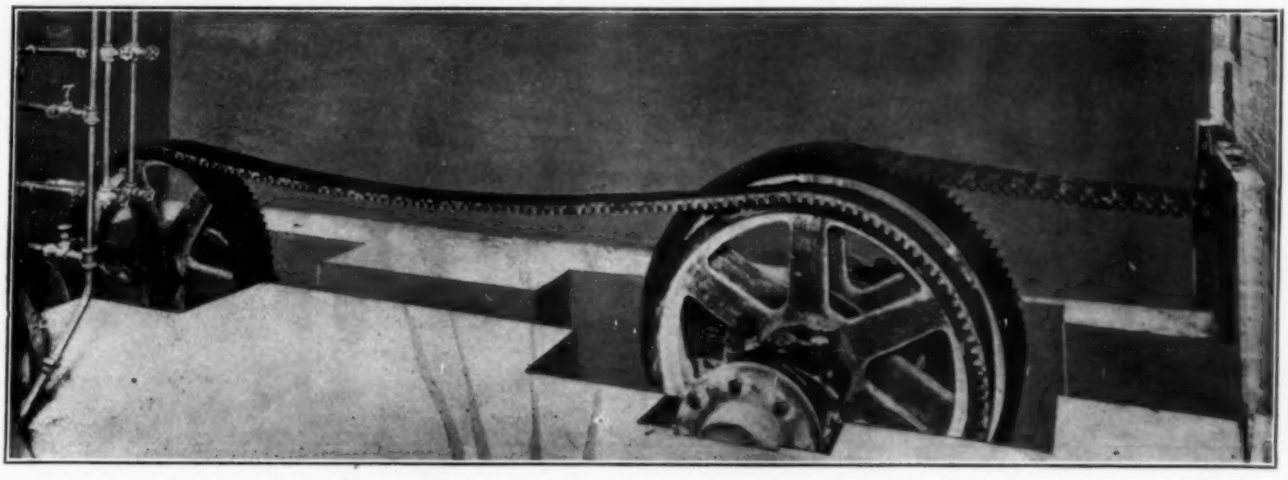


Fig. 2. A 350- and a 175-Horsepower Drive

tions per minute, with a 2-inch pitch chain, 10 inches wide, spaced on 150-inch centers, and has a chain speed of 1180 feet per minute.

Fig. 3 shows a 500-horsepower drive in the mill of the Boston Rubber Shoe Company, of Malden, Mass. Two strands of chain are used, the pitch being 2 inches and the face of each strand 10 inches. The speeds are 60 and 175 revolutions per minute, chain speed 1250 feet per minute, the sprockets having 125 and 43 teeth respectively, and the center distance being 96 inches. Of the date of starting this installation we are not informed, but its extent of service is about 10,500 hours.

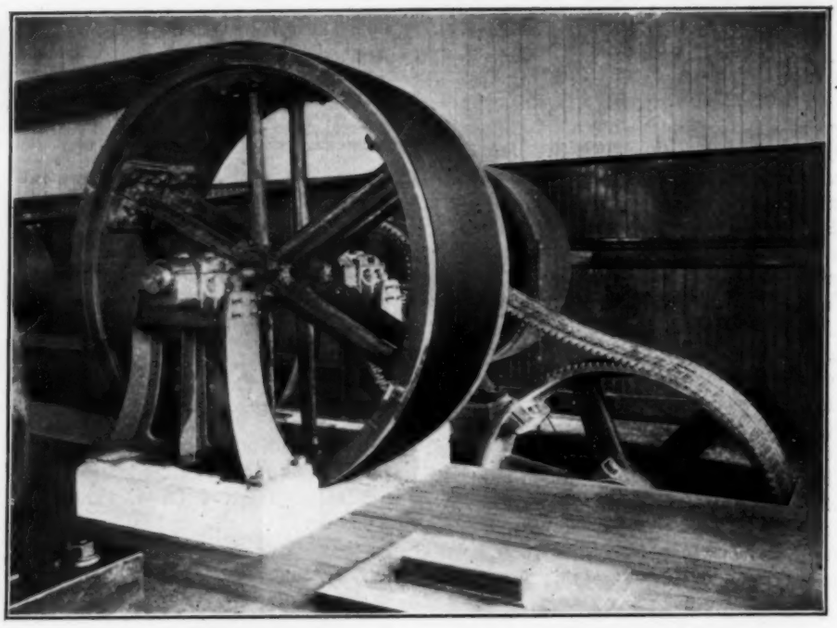


FIG. 3. A 500-HORSEPOWER DRIVE

THE LARGEST YET

The crowning achievement in chain driving is shown in Figs. 4 and 5, which illustrate the most recent installation at the mill of the G. & J. Tire Company, Indianapolis, Ind. The two photographs are given in order to show the actual appearance of the chains when at rest, and

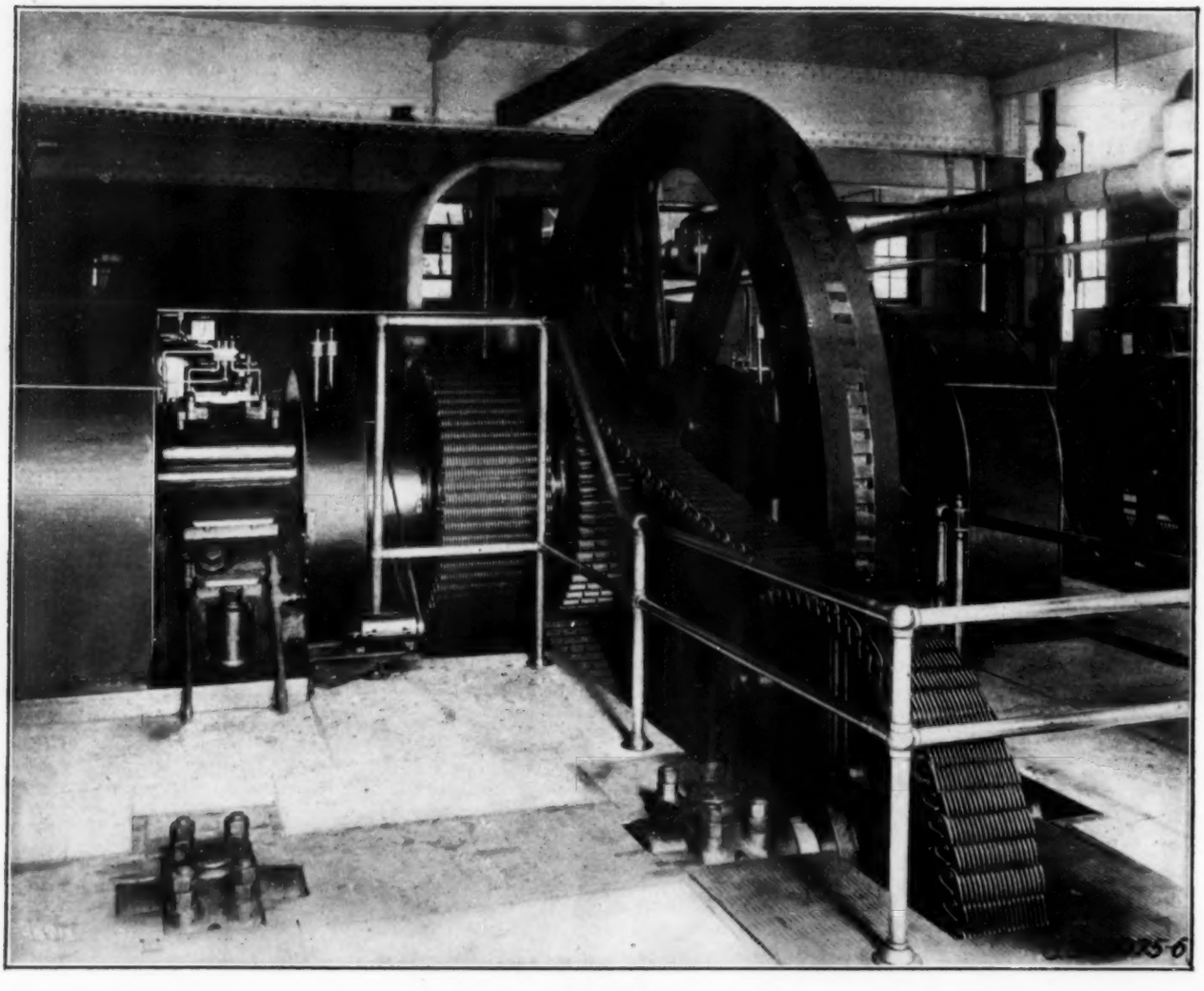


FIG. 4. A 1000- AND A 500-HORSEPOWER DRIVE AT REST

the remarkable smoothness of their motion when at work, when both chains are running at 1448 feet per minute. There are, as will be seen, two drives, the one in the foreground carrying 500 horsepower by a chain of 3 inches pitch and 12 inches face, with speeds of 95 and 75 revolutions per minute, sprockets with 61 and 77 teeth, and a center distance of 135.32 inches.

The 1000-horsepower drive is seen in the background and less satisfactorily than the smaller drive because of its location. This chain, like the former one, is of 3 inches pitch, but has a width of 24 inches. The speeds are 95 and 70 revolutions per minute, the sprockets have 61 and 83 teeth and the distance between centers is 103.24 inches. Both these drives were started in April, 1910.

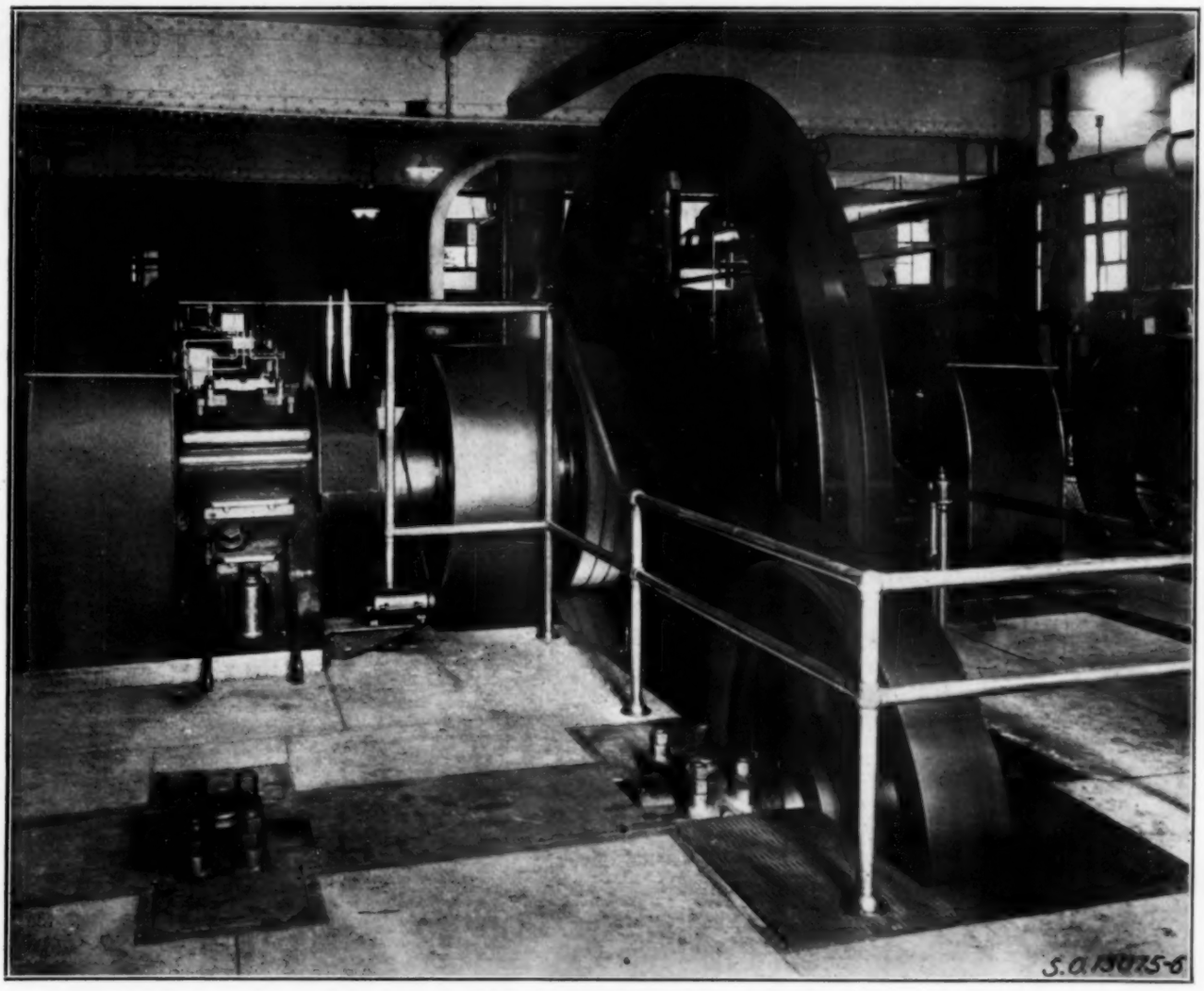


FIG. 5. THE DRIVES SHOWN IN FIG. 4 IN MOTION

THE COST

In view of the newness of this system of driving in such large units, our readers will be interested in the question of cost, and we are permitted to say that in the case of Fig. 1 the cost per horsepower for chains and sprockets was $5.42; of Fig. 2, $6.15; of Fig. 3, $4.20, and of Fig. 4, $3.98 and $3.67 respectively, these figures covering the chains and sprockets as delivered. The higher cost of the drive shown in Fig. 2 is due to the long center distance. As regards the satisfaction given by the drives in service, we are informed that none of them have required repairs of any kind.

LARGE AND SMALL DRIVES COMPARED

While chains of this magnitude have confessedly a somewhat formidable look, there seems to be good reason why they should give less trouble than smaller drives, which we are informed by the makers is a fact. In the drives referred to the rotative speeds are comparatively low, the speed ratios are small which permits the use of a large number of teeth in both wheels, and while the chain speed is high, the chains have driving contact with a correspondingly greater number of teeth so the link and tooth wear is almost negligible. The large number of teeth also decreases the amount of bend of each joint, and with the increase of pitch there are fewer joints where wear can take place, thus increasing the durability of the chain.

One of the most important considerations in large main drives is the cost and time required to make replacements or repairs to insure continuity of operation. The usual forms of transmission as well as chains are probably equally free from the necessity of repairs, but in maintenance cost it is possible that chains will make the more favorable showing, since the wear between the teeth of the wheels and the links of the chain (which does not change the pitch) being so small, the wear limiting the life is that which takes place between the joints themselves and the gradual seating home of the joints in the links, which permits the chain to lengthen in pitch and climb higher and higher until nearly the top of the teeth is reached, when the chain requires repairs or renewal. With the links still in good condition, this renewal does not require in even the largest chains more than ten to twenty hours, and is done by driving out the worn joint pins and inserting new pins enough larger to restore the chain to its original pitch

length, at a cost of 10 to 15 per cent. of the first cost of the drive.

THE FIELD FOR LARGE CHAIN DRIVES

Except as gears have occupied the field, the chain drive opens up new possibilties in the matter of compactness. When ropes or belts are used considerable center distances are a necessity, and when large center distances are required the conditions indicate a drive by belts or ropes. In many cases, however, short center distances would be used were it not that belt or rope driving requires long ones. The fact that short center distances are available frequently reduces the dimensions of buildings which ropes or belts would require and thus leads to a large indirect saving. In the case of Fig. 3, the location of the shafts being fixed, a preliminary layout of a rope transmission was made, the result being a three-story building to provide the necessary center distances and accommodate the intermediate sheaves and tension carriage—the whole arrangement being nothing less than formidable. Short center distances provide the natural field for chain drives, their only competitor for such case is being gears. In the matter of cost, chains are more expensive than gears, but against this, tests concur in showing a higher efficiency for the chains which, in plants of the magnitude shown, leads to a constant saving of enough importance to justify placing it against the greater initial cost.

The Design of Hoisting Hooks

By Axel K. Pedersen

A simple and usable designing chart with formulas showing the relations of the general dimensions. It is based on the curved beam theories of Professors Bach and Andrews-Pearson, and the straight beam theory. The curves from the curved beam theories agree within less than five per cent. The curve from the straight beam theory gives stresses very much too high, and is discredited.

In the AMERICAN MACHINIST, Volume 31, Part 1, page 170, I published a chart for designing hoisting hooks; the fundamental theory used was developed by Professor Bach in his investigations of the strength of curved bars under eccentric loading. It was pointed out that the results obtained agree very favorably with tests, and as a matter of fact this theory has received considerable attention by many prominent engineers in calculating eccentric loaded curved machine members. Generally, however, most technical literature does not consider this subject sufficiently and recommends "the straight beam theory" even for curved bars, by reason of its long standing or in ignorance of the fact that the stresses were greatly underestimated. In the paper mentioned I stated that a theory which neglects the radius of curvature of the beam is very dangerous to employ, especially in calculating hoisting hooks, as here loss of property and even of lives may be involved if the stresses produced by the load are under-estimated.

It is, therefore, very pleasing that considerable interest in the design of curved beams has recently been raised by the very remarkable tests and analytical investigations performed by Prof. Walter Rautenstrauch and published in the AMERICAN MACHINIST, Volume 32, Part II, page 615. The theory used is that laid down by E. S. Andrews and Prof. Karl Pearson, and the tests compare favorably with the stress equation derived from this theory. However, I cannot quite agree with the statement that the Andrews-Pearson theory seems to be the only one which is in any way verified by the results of experiments. A comparison of Professor Bach's theory with the Andrews-Pearson theory shows a striking conformity; the former is comparatively rather easy to apply and applicable to very many problems besides the hoisting-hook problem and is, therefore, deserving of the recommendation and employment which it has met.

EXPLANATION OF THE CHART

The chart printed serves to predetermine the important dimensions of hoisting hooks and is very simple to use; it involves very few calculations and is to some extent preferable to the one previously given as no crowding of lines impairs a clear general view, and as it can be used for hooks of any capacity. The ratio $H \div A$, see Fig. in the chart, is not a constant but can be varied within large limits; a variety of hooks of equal capacity may thus be designed to meet the manifold requirements and conditions for the shop and the specifications for maximum stress allowed.

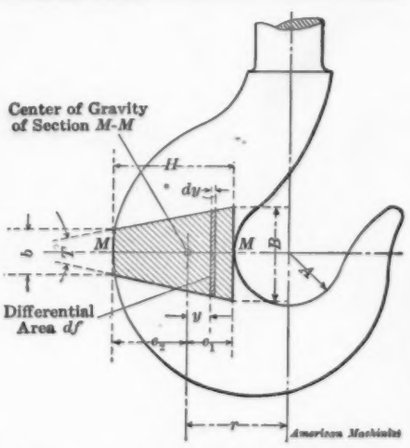


FIG. 1. DIAGRAM OF HOISTING HOOK WITH NOTATION

Referring now to the chart, three curves are plotted. The use of curve No. 3 would give hook dimensions consistent with "the straight beam theory" and is not recommended for practical use; it is, however, theoretically very interesting as it proves the great overestimate of the strength of hooks calculated according to this theory. The curves No. 1 and No. 2 are plotted according to the theory of eccentric loaded curved beams, curve No. 1 representing that by Andrews-Pearson and curve No. 2 that by Bach.

The following formula can be proved for the three different cases:

$$F = \frac{A^2 \cdot \tan. \frac{T}{2}}{\left(\frac{P}{s}\right)}. \qquad (A)$$

Herein

F = A factor varying with the ratio $x = H \div A$ and dependent on the theory employed.

A = The radius of the inside of the hook, inches.

H = The depth of the hook, inches.

T = Included angle of taper for the trapezoidal section used.

P = The load in pounds.

s = Maximum allowable tensile stress in pounds per square inch.

Denoting

F_1 and s_1 as the factor and stress respectively for hooks according to the Andrews-Pearson theory.

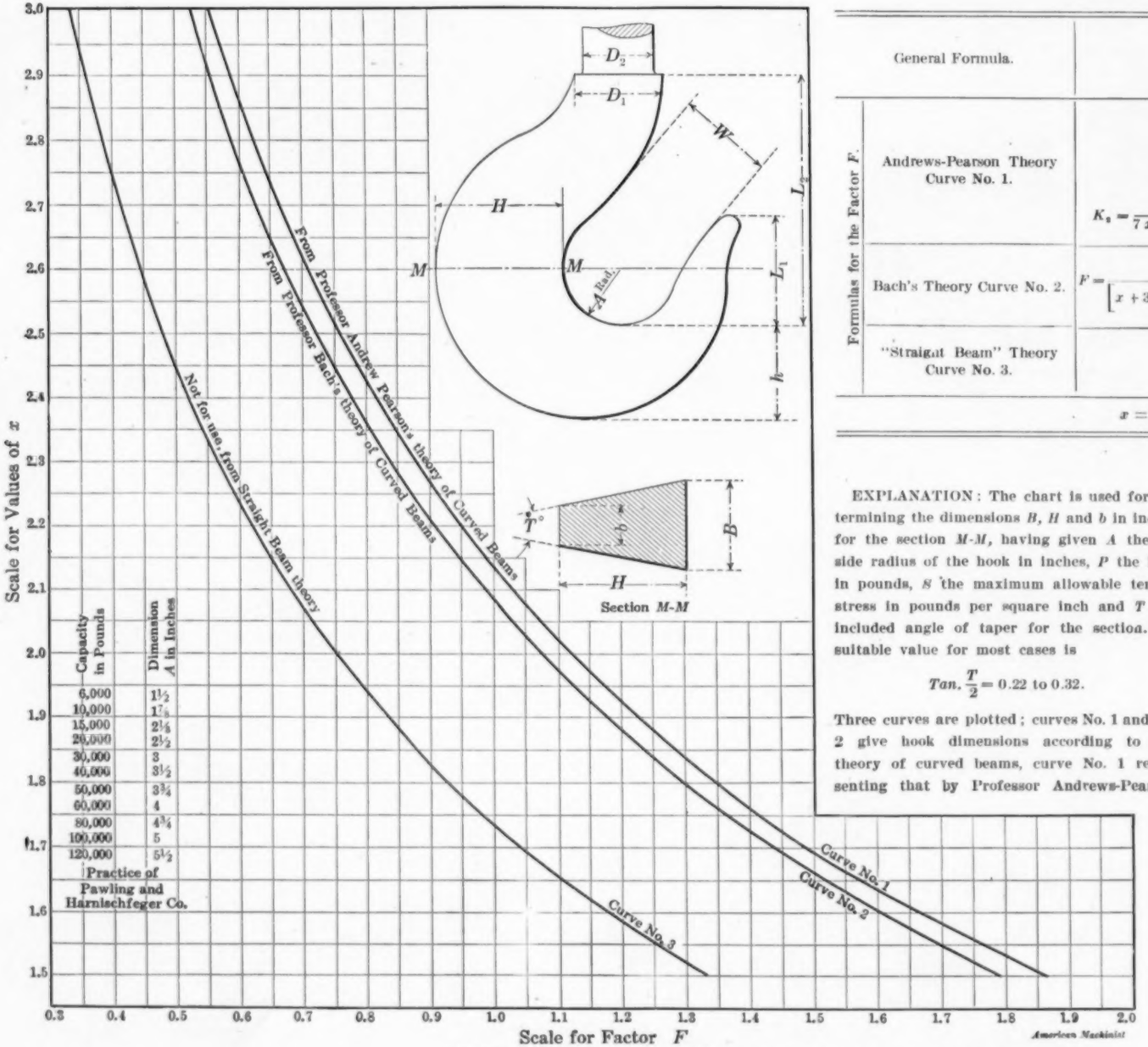
F_2 and s_2 the same items according to Bach.

F_3 and s_3 the same items according to "the straight-beam theory." Then for a hook of a particular design and capacity we would have from formula (A):

$$F_1 = \frac{A^2 \cdot \tan. \frac{T}{2}}{\left(\frac{P}{s_1}\right)}.$$

$$F_2 = \frac{A^2 \cdot \tan. \frac{T}{2}}{\left(\frac{P}{s_2}\right)}.$$

$$F_3 = \frac{A^2 \cdot \tan. \frac{T}{2}}{\left(\frac{P}{s_3}\right)}.$$



DESIGNING CHART FOR HOISTING HOOKS. BY AXEL K. PEDERSEN

General Formula.		$F = \frac{A^2}{\left(\frac{P}{S}\right)} \cdot \tan.\frac{T}{2}$
Formulas for the Factor F.	Andrews-Pearson Theory Curve No. 1.	$F = \frac{1}{x\,(x+2)} \cdot \frac{1 - K_2}{K_1 - K_2}$. $K_1 = \frac{8}{3x\,(x+2)} \cdot \left[3x + 7 - \frac{4x+7}{\sqrt[4]{x+1}}\right]$. $K_2 = \frac{8}{7x\,(x^2+6x+6)} \cdot [(4x+11)\sqrt[4]{(x+1)^3} - (7x+11)]$.
	Bach's Theory Curve No. 2.	$F = \frac{x+3}{\left[x+3+\frac{3\,(x+2)}{x}\right][(x+2) \cdot \sqrt[3]{3} \cdot \log.\,(x+1) - 2x] - 3(x+2)^2}$
	"Straight Beam" Theory Curve No. 3.	$F = \frac{3}{x^2}$.
		x = ratio $H \div A$.

EXPLANATION: The chart is used for determining the dimensions B, H and b in inches for the section M-M, having given A the inside radius of the hook in inches, P the load in pounds, S the maximum allowable tensile stress in pounds per square inch and T the included angle of taper for the section. A suitable value for most cases is

$$Tan.\frac{T}{2} = 0.22 \text{ to } 0.32.$$

Three curves are plotted; curves No. 1 and No. 2 give hook dimensions according to the theory of curved beams, curve No. 1 representing that by Professor Andrews-Pearson and curve No. 2 that by Professor Bach. These two curves can be used arbitrarily as the results obtained agree closely with tests. Curve No. 3 would give hook dimensions consistent with "the straight beam theory" and is given for comparison only and should *not* be used for calculation; it proves the great overestimation of the strength of hooks calculated according to this theory.

To find the dimensions H, b and B proceed as follows:

Calculate the factor

$$F = \frac{S}{P} A^2 \tan.\frac{T}{2}.$$

Locate this value on the F-scale and from this point trace parallel to the x-scale to curve No. 1 or curve No. 2, and read the value of x on the x-scale.

Then the required dimensions H, b and B are found from the following formulas:

$$H = A\,x, \quad b = 2\,A \tan\frac{T}{2}, \quad B = b\,(x+1).$$

For determining the general dimensions of the hook the following relations may serve as a guide:

$D_1 = \sqrt{P_1}$ where P_1 is the load in tons of 2000 pounds. $D_2 = 0.875\,D_1$, $W = 1.5\,A$, $h = 0.75\,H$ to $0.9\,H$, $L_1 = 2.3\,A$ to $2.6\,A$, $L_2 = 4.3\,A$ to $4.5\,A$.

which give the following proportion

$$F_1 : F_2 : F_3 = s_1 : s_2 : s_3. \qquad (B)$$

Now consider a hook with the ratio $x = 2$, then we get from the diagram: $F_1 = 1.125$, $F_2 = 1.075$, $F_3 = 0.75$, and by formula (B) and for $s_1 = 10{,}000$ pounds per square inch we would have $s_2 = 9540$ pounds per square inch and $s_3 = 6660$ pounds per square inch. This proves the very great underestimate of the stress for hooks proportioned according to "the straight-beam theory"; in this case the actual stress produced is about 50 per cent. greater; whereas the discrepancy—about only 4.5 per cent.—between the two theories which take in account the curvature of the beam is sufficiently small to justify both, if tests corroborate one of them. The tests by Professor Rautenstrauch confirm remarkably well the theory developed for curved beams, the discrepancy in no case exceeding 6.5 per cent.

All information necessary for calculating and designing is given in the chart except only the dimension A, which is determined by the consideration of suitability for the work. In the lower left-hand corner of the chart will be found a table of this dimension which is included through the courtesy of the Pawling & Harnischfeger Company.

The Purposes of a Cost System

By Holden A. Evans*

Are dividends being paid from profits or capital? Is every line of product a money maker? Is every department of the plant a money maker? The purpose of a cost system is to answer such vital questions as these.

*Naval constructor, United States Navy.

There is a remarkable lack of interest on the part of many owners and managers in accurate cost accounting. Approach a manager to tell him of a new tool or appliance which will reduce the cost of production and he is immediately interested. He listens to the explanation of the new machine and if it appears to have merit he investigates its application to his work, and if he sees that the reduction that can be made in production costs warrants the outlay, he will purchase. Not a few managers employ outside experts to study the products of the concern and the methods of manufacture in order that better suited machine tools may be provided or better appliances devised. The manager knows that these methods mean progress; that by them greater efficiency is obtained and the cost of production reduced. This increases profits and he is not only interested because of the pecuniary reward, but also because increased profits mean success.

Nearly all men are more interested in what the world calls success than in the pecuniary rewards that come with success. To the majority of men the striving for success and its attainment makes life worth living.

It is very different in regard to suggested improvements in the cost system. To many managers detail cost figures are not an essential part of the system that brings success. To a great many costs are mere data—the record of what is past and gone. To such, costs are a necessary evil—necessary in that they are required to tell whether the manager has failed or succeeded, and this to many is told only by the final balance.

Very few managers can tell how their costs are kept. They can tell in detail every operation in the shops, because they know the importance of these and are interested. They do not know the value and importance of costs and they are not interested. They leave the cost keeping to the bookkeeper and the cost clerk. They consider this a detail of the organization that can well be left to poorly paid clerks. Interest in scientific shop management will bring intelligent interest in costs, for scientific management cannot exist without accurate costs. An organizer cannot intelligently organize unless he knows conditions, and an accurate cost system is an exact record of the conditions. It is the pulse of the organization and every beat that is out of harmony in the organization is faithfully recorded.

Little Literature on Cost Systems for Manufacturing Establishments

A manager who desires to obtain satisfactory literature on cost accounting as applied to manufacture and repair shops may make a wide search and still not be well rewarded. He will find a large number of books on accounting, many of which are excellent, as commercial accounting has received wide attention and has been carefully considered by experts. In nearly all of these books there are a few chapters on cost keeping for manufacturing concerns, but the treatment of this subject is not satisfactory. It is treated from the point of view of the expert accountant, and this is not the same as that of the progressive manufacturer or the expert shop organizer. The subject is considered in an academic way, and the methods suggested have not been worked out in detail and applied to a manufacturing concern. There is, however, much to be learned by the progressive manufacturer from these excellent treatises on commercial accounting, and he will do well to study carefully the principles of accounting, as the information gained will be of great assistance in devising a correct cost system.

It is seldom that a paper on cost methods is presented to an engineering society. Many members believe that such papers have no place in the records of the society. They do not consider cost accounting a technical subject, or a part of their profession. They consider that this is work of bookkeepers and not engineers. If, by chance, a paper on this subject is presented, it does not excite general interest and the intelligent discussion is confined to a comparatively few members.

In the technical journals every small improvement in plant equipment is fully described and improved methods are discussed in detail, while little space is given to improvements in cost systems, and it is seldom that a comprehensive article on this subject is found.

The lack of information in the technical press on this important subject is due entirely to the lack of general interest in the subject on the part of engineers, managers and owners. The technical press is very much like the modern newspaper—it publishes what its readers want—that which they demand.

What Can Be Learned from a Proper Cost System?

Every operation of the plant can be read from the cost figures. The costs day by day represent actual work—actual progress of each job toward completion. In a proper system these costs are so recorded that a manager or his assistant can ascertain from the office what is taking place in the plant. He sees whether or not a rush order is receiving proper attention, and knowing the approximate total cost for direct labor, can tell whether at the present rate the job will be completed in the promised time. He can tell whether all departments are proceeding as they should to make the many parts come together at the same time for final assembly.

With his knowledge of the job he knows the department which must take up the work first, and approximately how much must be done before the work can be delivered to the next department. He knows how much preliminary work can be done by the second department to enable it to proceed rapidly when the product of the first is obtained.

With his knowledge of the work itself and with the daily records of the

direct labor conveniently recorded by shops and trades he can tell exactly the progress made in each department.

Many will say that this can be learned from the shops and that the shop is the place to obtain this information. The information can be obtained from the shops, but to do so the job must be followed from shop to shop and perhaps from machine to machine. Few managers have the time to do this. In their rounds through the shops many affairs occupy their attention and they have little time to follow a job in this manner. It is often in the office that a manager has a job of work brought to his attention and wishes to know what has been accomplished in each department. To telephone to each department head for this information is unsatisfactory. If he can obtain the information from the cost cards he is in a position to study the job as a whole and plan his actions.

By means of the cost system under which I lately operated, the direct labor costs are accurately recorded and so arranged that each day the costs by shops or trades can quickly be obtained. Each of my assistants received the job-order cards of the work under his supervision at 4 p.m. every day. Many of these cards receive but superficial examination, but those for important work receive careful scrutiny. First, the totals of the direct labor costs are known and with general knowledge of the progress of the work the efficiency of operation is measured. The estimated cost of each job is given on the card and it is therefore known how much money remains of the direct labor estimate with which to complete the work. The jobs that have overrun the estimates, or are in danger of overrunning are picked out and investigated and the reasons for this condition determined. This brings forth better supervision on the part of foremen of what might be called the dangerous jobs.

The progress of the work in each department can be approximately determined and departments that are behind can be accelerated. For example, in a large pipe job, the charges show that the pipe shop has made material progress while the foundry has done little or nothing. Before the work can be completed the flanges and fittings must be cast in the foundry and machined in the machine shop. Either the pipe shop is too fast or the foundry is slow. A note is made of this job and the conditions investigated the following day. The accuracy of charges against jobs is also tested. On a number of jobs the assistant knows exactly the men who worked the previous day and with this knowledge checks the charges made against the job order. In actual practice it was found necessary each day to issue a considerable number of memoranda to foremen asking for explanations or giving suggestions and directions.

It has been found convenient to go over the job-order cards after the usual working hours when this can be done undisturbed, and to dictate the notes regarding the work to a dictating machine, to be written and sent out the following morning. This use of costs gives a manager and his assistants a much better grasp of the situation, puts the manager in closer touch with the work, and brings each day to his attention important facts which otherwise might escape him.

The notes that I make from the afternoon scrutiny of the job-order cards have been of great value in planning the following day's work. Frequently on Sundays or at night I go over the job-order cards of the important work. At these times I am undisturbed and devote my whole attention to a study of conditions as shown by the cost records. In these days of competition there are few managers who do not sometimes find it necessary to study the operation of the plant outside of working hours. At these times the cost records should supply the necessary information. Accurate costs properly recorded are the sign boards pointing directly to inefficient methods and inefficient service.

There is another important benefit to be derived from this use of costs. The working force soon knows that the history of each department is recorded by the costs, and that each day the story is told to the responsible head, and that any dereliction will be immediately noted and corrective measures applied. This knowledge brings forth better supervision on the part of superintendents and foremen, and better efforts on the part of workmen, and consequently increases efficiency. Every manager knows that when the cost of a job is watched day by day the total cost will be much less than if the work had not received this attention. Nearly every manager has at some time watched the cost of a job in which he is particularly interested and he knows that his watchfulness has brought excellent results. Then, why is any argument needed to strengthen the plea to watch all costs in the same manner?

To do this a system must be provided which presents true costs in a convenient form so that the figures may be readily analyzed.

It is true that in a large establishment with many job orders it will be impossible for the manager to go over the cards for each job. He has assistants who can do this, and these will bring to his attention all important matters and all exceptions which they are unable to handle.

While the above described daily scrutiny of cost by job orders refers to direct labor costs, it must not be inferred that the material charges should not receive attention. The cost-of-work cards show the charges for labor, material and indirect expenses. These are recorded by months, the labor being taken from the job-order cards, the material from the storekeepers' bills, and the indirect from the expense-distribution sheet. These should be scrutinized not less than once a month.

I have found these uses of costs to be of the greatest assistance in an organization employing 1500 to 2000 men, distributed in a number of shops. There is little doubt that similar use will be of benefit in a smaller plant.

Manager Scrutinizes Each Month All Indirect Charges

With a proper system of costs there will be presented to the manager each month a complete analysis of all of the indirect charges. This will show for each shop the indirect charges under appropriate heads and the total shop expense. The general expenses will also be shown in a similar manner. The productive labor in each shop should also be shown and the proportion of each expense to productive labor given. The distribution of the expense burden to the output should also be given. By means of parallel columns, or better, by means of curves, each of the various factors should be plotted by months, so that the manager can see at a glance whether the tendency of each expense is up or down. With this information the manager can see exactly where the money for the expense burden goes. He will note that one item of expense is very large, but he knows the reason. There has been a breakdown which involved a large expenditure for repairs. He notes another item which is higher than usual, and for which he does not know the reason. He checks this item for a detail of labor and material. Thus, he goes through the monthly expense reports, noting exceptions for further details. These details are prepared for him and unless they show to his satisfaction that the extra expenditure is warranted he is in a position to take up the question with the department head and will require satisfactory explanation or apply corrective measures.

He can at various times take up the expenses shop by shop, item by item, and have a complete analysis and detail study made to see if the expense for this shop can be reduced without reducing the output or without injury to the plant equipment. This is not only for the purpose of stopping leaks, but also for devising better methods or better appliances. In this, as in all other work, it will be found that when it is studied in detail and systematized the expenditures can be materially reduced without injury to the plant or without reducing the output. By such a system of costs the manager is not only able to see clearly the operation of the plant, but the leaks and deficiencies stand out and he can apply the remedy. He is armed with absolute knowledge and does not have to guess; when he calls for an

explanation from a subordinate it will be useless for the subordinate to attempt to evade or bluff, for now the manager *knows*.

Monthly Balance Desirable

Very few manufacturing establishments and practically no repair shops make a monthly balance. There is no necessity for waiting until the end of the year to determine if the concern is making or losing money. This can and should be known at the end of each month. A proper cost and accounting system shows this and there can be no question that the concern with this information is in a far stronger position than one without it. To obtain a monthly balance in an establishment like a ship yard where large contracts are taken which require several years to complete it is necessary that an estimate be made each month of the value of the output on such contracts. Practically all contracts of this kind are paid for as the work progresses, as no firm cares to finance a five million dollar contract. This requires that from time to time careful estimates, based on the total contract price, shall be made on the value of the work accomplished, in order that payments may be obtained. These estimates are carefully checked by the purchaser and are usually conservative. The same system may be employed to show each month the value of the work accomplished on each large contract.

The monthly balance is another case of a proper system giving information that is well worth while, information which prevents the manager from acting in the dark. It is also of value to the owner or the board of directors in a stock company. Sometimes owners or directors are in ignorance of the actual conditions and believe that large dividends are being earned when such is not the case. This condition is not unusual when a concern is principally engaged in executing large contracts which require several years to complete. A manager may obtain at low prices a number of such orders and the concern has every appearance of prosperity, and the owner is led to believe that large profits will be secured when the contracts are completed. Without an accurate cost system there is no way by which the estimates made by the manager can be checked, other than to engage an expert to go over the work in detail and estimate the value, and compare this with the expenditures; but the owner has no reason to consider such action necessary. When the work is completed, instead of profits there are enormous losses. This case is by no means an extreme one and at least one large manufacturer can testify to the correctness of the statement.

Purchasers of large properties may be deceived in the same manner and under the veil of apparent prosperity losing establishments are sometimes sold at very advantageous terms. No doubt some of the readers of this article have better knowledge than I of the losses due to buying under these conditions. These regret that accurate cost keeping and accounting were not more general, or at least were not employed in these plants, for such operations would have then been impossible.

Dividends that Are Paid from Capital and Not from Profits

A proper cost system shows the actual profits, but frequently with the systems in use the records show profits which are not real. In many concerns, particularly the small establishments, in arriving at costs no account is taken of depreciation, or if it is considered, the allowance made is inadequate. In these cases the profits shown are apparent and not real. The owners, however, do not realize that the dividends which they receive are at least partly derived from the principal and not from profits. This subject will be discussed in more detail in a subsequent article.

Few concerns know whether or not every line they make and sell is a money maker. They cannot know with their present cost system. Is this good business? Surely not! Many, however, depend on the cost system to show a profit or loss at the end of the year, and are satisfied if a substantial profit is shown. These are neglecting their opportunities. Oftentimes one product should show a substantial loss which is made up by large profits on the others. A proper cost system will show the profits on each line. If the losses on the losing line cannot be turned into a profit by improved efficiency, then that line should be abandoned and all energy concentrated on the profitable lines.

In some foundries costs are kept, and selling prices are fixed on a tonnage basis. The costs of large simple castings are averaged with those of the small difficult ones. It is hardly necessary to point out that the selling prices of the large castings are too high while the small are too low. If it is known to buyers that costs are kept in this way orders for small castings will be plentiful.

I know of one large concern that places its orders for castings in this manner. The small and medium-sized castings go to the concern where costs are averaged, while all of the larger castings go to another where costs are properly kept.

I recently visited a shop that used a number of small steel castings weighing less than a pound each, and learned that they were obtained at ten cents a pound. The foundry that made these is a small plant using the Tropenas process. The cost records are of no value in fixing selling prices, and many orders were taken at an actual loss. This steel plant went out of business.

Is Every Department of the Plant a Money Maker?

A large concern usually consists of many departments. Is each of these a money maker? Is each shop efficient? If not can it be made efficient? These are important questions and every capable manager wants satisfactory answers, and he should have them to manage the establishment properly. Let managers ask these questions, and few will receive satisfactory replies, although a proper cost system provides the data.

In some of the large establishments with numerous shops the expense burden is averaged and applied on the basis of productive labor—notwithstanding the fact that in one shop the shop expense percentage is nearly a hundred while in another it is less than twenty-five. Frequently such establishments are called on to bid for work which is almost exclusively confined to the shops where the expense is low, and by using the higher average rate the bids are high and the work goes to other establishments where costs are more accurately determined. Thus, profitable work is often lost. Sometimes the establishment which is known to be better equipped and more efficient loses in this way to the poorly equipped, inefficient shop, and the latter makes money. I know of at least one establishment which lost so many profitable repair jobs in this manner as to cause general comment, yet apparently the real cause was not known to those in authority.

What is Good Judgment

A great deal is heard of good judgment, and men who possess this quality command high salaries. Often an establishment which has secured such a man depends almost entirely on his "good judgment" for better results, and it is considered that with this he can overcome the lack of organization, cost system, or even of plant equipment.

A good mechanic to produce the best work quickly must have good tools with which to work. If he is not given these a less efficient man with better tools can produce better results. The same applies to the manager. A manager with good judgment is extremely valuable, but he must have the tools with which to work. If he does not obtain them a man of less ability with better organization and better equipment will outdistance him.

Good judgment is the application of knowledge gained by experience. This is derived partly by direct observation and partly from statistics compiled by others which have been digested and the salient points retained. If the manager is really a man of "good judgment" he will provide himself with the organization and the system which will furnish him with correct information. An accurate cost system is an essential part of such an organization.

Industrial Schools and Apprenticeship

By Dexter S. Kimball *

The general solution of the problem of industrial education must be by means of public industrial schools where such fundamentals will be taught as will prepare boys and girls for the industries of the surrounding territory—remembering that the aim and end of all education is to train men and women to think.

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In a former issue, page 104,* I pointed out the necessity of industrial education not only for those who are to actually engage in industrial pursuits, directly or indirectly, but also for all others; as only by industrial education in the broad sense can the nation be brought to a realization that individual and national well being must have their foundation in material prosperity. Undoubtedly a system of education which will produce this result is a long way in the future and at present the nation is only concerned, apparently, with the industrial education of those who are to take an active part in production. Yet this broader view must be kept in mind in planning our educational system for these, else the system will fail of its purpose, which should be the enlightenment, industrially and economically, of the entire producing class.

Granting, then, that a system of industrial schools is needed, the question naturally arises: What shall be the character of these schools? It is on this point that we have the greatest diversity of opinion, and many conflicting views. Of the many debatable points, however, two stand out somewhat above all others; namely:

(1) To what extent is it possible to give practical trade instruction in organized schools?

(2) Shall the new industrial schools be formed by remodeling our existing schools, or shall they be differentiated from them?

The second of these questions will be considered only sufficiently to complete the discussion of the first, as a full consideration of it would be beyond the scope of this article. It may be well at this point to indicate and define two types of schools which are being much discussed; namely, *trade* schools, which are organized to teach specific trades, i.e., to impart *special* training, and *industrial* schools, or those of a broader type, which are organized to give training in fundamentals, i.e., to impart *general* industrial skill and knowledge. The terms trade school and industrial school will be used to designate these types of schools.

The views which have been expressed regarding the first point are many, various and very conflicting, ranging all the way from the assertion that trades may be successfully taught in schools, to the extreme opposite view that trades cannot be taught in schools at all. As is usually the case the truth most probably lies between the two extremes. While some of these extreme views are based on limited experiences, one way or the other, they are for the most part largely speculative and not in keeping with what experience we have had on a large scale in work closely allied to that contemplated by the present movement.

It may be helpful to study for a little the general characteristics required in the men who successfully fill places in this complicated structure called the industrial field. Aside from inherent ability and general and cultural knowledge the accomplishments which these men must possess may be divided into three kinds.

(a) Manual skill.

(b) Scientific knowledge.

(c) Manufacturing knowledge.

The first is self-explanatory. The second refers to the knowledge of the natural scientific laws which may, in general, be acquired from books; and which it is generally conceded may be very successfully taught in organized schools. The third refers to the knowledge of shop processes, methods of manufacturing and the finance and economics of production. It is to be especially noticed that (a) and (c) are very different in character. A workman may be very skilful at certain operations, but be wholly uninformed regarding manufacturing in general; conversely a high-grade designing engineer may and must have a broad knowledge of many shop methods and processes which he himself is utterly unable to perform.

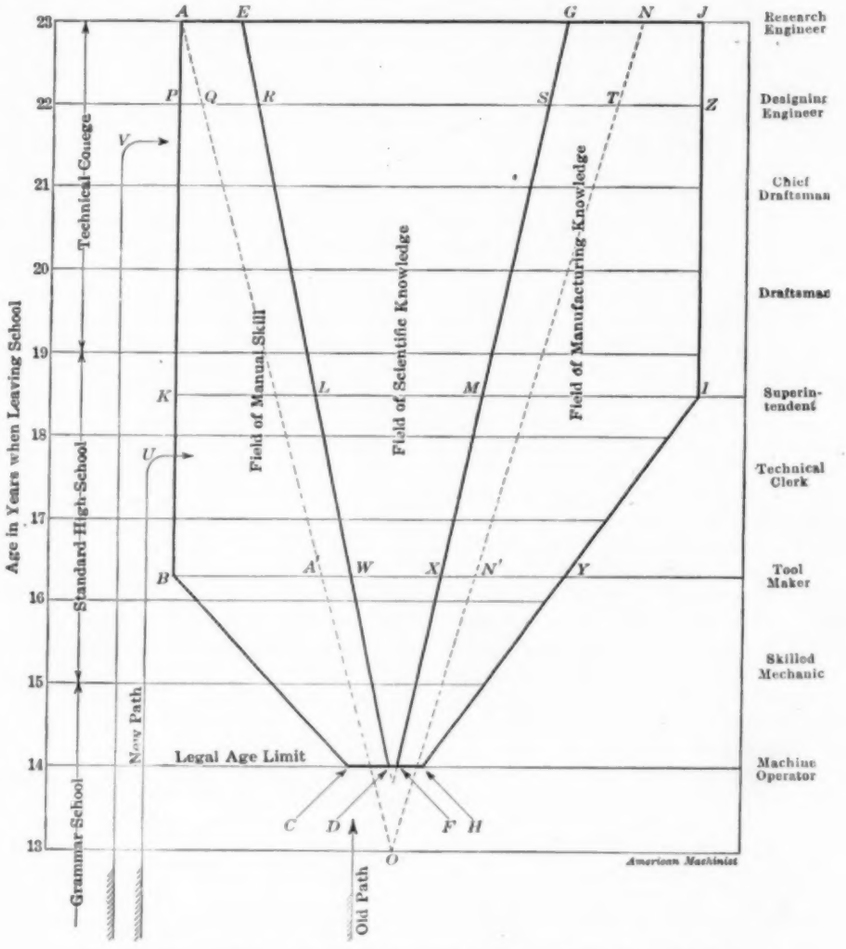

FIG. 1. DIAGRAM OF RELATIVE VALUES OF TECHNICAL KNOWLEDGE IN SEVERAL FIELDS

GRAPHICAL PRESENTATION OF RELATIVE VALUES OF TECHNICAL KNOWIEDGE IN SEVERAL FIELDS

The *minimum* amount of each of these three branches which the successful industrial worker must possess varies with his location in the industrial field; and the preparation which is given him to

* "Broader View of Industrial Education."

enter the field at any point must take the combination into account. These combinations may be shown graphically, and Fig. 1 represents, approximately, the relative values of the three requirements at different parts of the field, as applied, for the sake of being specific, to manufacturing based on considerable scientific knowledge, as is the case in electrical or steam-turbine construction. A similar analysis applies, however, to all professional education. In the diagram, *A B C D E* represents the field of manual skill; *E D F G* the field of scientific knowledge, and *G F H I J* the field of manufacturing knowledge. If a horizontal be drawn across the diagram the intercepts made by the lines bounding each field may represent, approximately, the degree of attainment in that field which the successful industrial worker at this point must possess. The entire diagram is to be taken as approximate and relative only as it is impossible, evidently, to lay down exact measures for such diverse requirements as presented by the industrial field itself. However, the general truth of the diagram must be evident. For instance, the successful superintendent should possess manual skill, scientific knowledge and manufacturing knowledge in proportion to the intercepts *K L, L M, M I*. The toolmaker must possess a maximum of skill and be well informed in shop processes. Again, for the higher types of engineers, manual skill, though highly desirable, is not so important as scientific and manufacturing knowledge. The designing electrical engineer, for example, must be well informed regarding a hundred shop processes which he is unable to actually perform; while for the highest types of engineers manual skill may be a minimum.

The position to which an industrial worker may attain is coming more and more to depend on his store of scientific knowledge. The scientific background which he obtains in school is, therefore, a measure of the hight to which he may attain. This is not universally true, of course, as some men continue to educate themselves in *fundamentals* after they leave school; but the great majority build up their scientific attainments after graduation only as high as the fundamentals obtained in school will permit them. The *total* amount of knowledge, scientific and practical, which the boy may acquire in schools may be taken, without great error, as proportional to the *time* spent in school.

If, therefore, the hight of the diagram be proportional also to the time spent in school, and if it be conceded that practically all the scientific background may well be acquired in school, then the diagram will also indicate the length of time the boy must stay in school to be logically fitted to take a given position. For example, a boy leaving school at 22 with a scientific training represented by *R S*, may well be expected to fill a position well up among engineers.

The amount of skill and manufacturing knowledge which can be imparted in our schools as at present organized, is small compared to the total time spent in school. And even though manual training were begun at the age of 13, the lines *A O* and *N O* indicate the best we may do in these directions with our present schools organization. Thus the aforesaid boy of 22 on leaving schools would have manual skill as represented by *Q R* and manufacturing knowledge by *S T*. The boy of 16 whose scientific background would logically fit him to be a toolmaker, would possess manual skill as represented by *A' W* and manufacturing knowledge as represented by *X N'*, which are only a limited part of the skill and practical knowledge required. It is to be especially noted that the proportion of these practical fields which the boy may acquire in school is increasingly greater the longer he stays in school. The general truth of the foregoing is well authenticated by statistics of our public schools and colleges.

The Old Apprenticeship Systems

The old apprenticeship systems taking the boy at the bottom of the diagram, slowly worked him upward, the apprentice acquiring, largely by absorption (seldom by actual teaching) the combination of these three elements which finally located him in the field. It must be remembered that the distance to the top was not then so great, as scientific knowledge and the economics of manufacturing have grown tremendously during the past 25 years; but even then the way was long and toilsome. The passing of the old apprenticeship system is not to be regretted, as it is hard to imagine a system so uneconomic and in some respects so unfair as this system. I, myself, served one of these "good old-fashioned apprenticeships" under extremely favorable circumstances, and have had the opportunity to observe many others; and can therefore speak from actual experience.

Changed methods of production and the extension of the principle of division of labor have rendered these old systems obsolete; and progressive manufacturers long ago realized that the old apprenticeship methods were not only impossible under the new conditions, but that they were also uneconomic. Many concerns in this country have, therefore, within recent years introduced new forms of apprenticeship systems which are worth more than a passing thought. They are varied* in their character, ranging all the way from slight modifications of the old system to high types of industrial schools; and even a hasty description of any of these is beyond the scope of this article. It is to be especially noted, however, that in practically all of them *organized* instruction is provided at least on the practical side; that in most of them some provision is made for school instruction in the related scientific branches of the art; and that only in the few, such as that at the Lynn works of the General Electric Company, is organized instruction in all three elements of Fig. 1 imparted in a separate training school *before* the boy is transplanted to the shop proper. This last type of apprenticeship system brings the boy into the industrial field partially equipped at least, with all three of the required elements, in exactly the same way it is proposed to bring him in under a system of industrial schools. While, therefore, the old apprenticeship system is dead, the new systems are very much alive and growing, the most highly developed rivaling good industrial schools; and any discussion of industrial instruction must take account of this phase of the question.

*For a very masterly discussion of modern apprenticeship systems see *Bulletin* No. 6, of 1908, United States Bureau of Education, by Carroll D. Wright.

Advantages, Disadvantages and Limitations in Factory and Industrial School Trainings

Confining the discussion for the present, to the lower part of the diagram, Fig. 1, what are the advantages and what the disadvantages of training industrial workers entirely in the factory; and what the advantages and limitations of the public industrial or trade school, which is entirely independent of the factory?

There can be no doubt but that a well organized apprenticeship system presents many advantages. The boy may earn something while he is learning his trade; and this is an all important matter to many parents. So important is it that should compulsory educational laws compel the attendance of boys in industrial schools longer than at present, the State may be in duty bound to assume the financial deficit created by such action. He would possess no false ideas of his value, which might be the case with boys partially trained in industrial or trade schools and as students of technical schools of higher order are likely to hold. And beyond all doubt the major part of the necessary manufacturing knowledge, the knowledge of shop methods and processes, the knowledge of *men*, and the thousand and one details of information that go to make up the well rounded out worker can be acquired only in the atmosphere of the art itself.

On the other hand, the apprenticeship system as usually organized is very wasteful of time, much of the boy's time being applied to work which is more or less drudgery. This is, of course, not economical either for the boy or the employer; and wise manufacturers now look after this point carefully. The tendency of the shop atmosphere is to accent the shop side to the neglect of the academic side, without instruction in which no mod-

ern trade instruction can be considered effective. Carroll D. Wright, as a result of a careful survey of this field, says: "The majority of the concerns having an apprenticeship system fail to provide in their works definite instructions in the related subjects of mathematics and science. An investigation shows that they 'encourage' boys to attend public evening schools, mechanical institutes and the Young Men's Christian Association classes. Careful investigation shows that this encouragement lacks definite results."

Many of the industries are so narrow that even with the best form of an apprenticeship system now in existence the outlook of the worker would be too narrow to meet the specification of modern ideas. An apprenticeship system will, necessarily, be operated in the interest of the employer; and none but the best boys will be taken into the shop. Many manufacturing concerns cannot afford the necessary facilities for instruction in the allied academic branches. Again there are some industries, like the shoe industry, in which the work has been so minutely divided that apprentice instruction is no longer possible to any appreciable degree. And lastly, there are very few companies large and prosperous enough to afford a training school of their own that would give the required practical and academic training. These last five items show clearly that even could the apprenticeship system be fully developed many boys must necessarily be left uncared for or their education must necessarily be defective should we attempt to depend on apprenticeships alone. And, what is still more important, the apprenticeship systems make no provision for the so called "wasted years" from the ages of 14 to 16, which are so valuable for industrial training, boys generally not being wanted in the trades much before 16 years of age.

The industrial or trade school is economical of time and can therefore impart a given degree of manual skill in fundamental operations in less time than is usually required in the shop. It may be and should be open to all; and each and every student may be given the same drill in fundamental operations, since the complications of the shop are not present to interfere. The instruction even in the practical side may be thoroughly systematized and not be haphazard as in the shop, the work being illustrative in its character and the sequence such that maximum efficiency is attained over a wide range. The academic training in the related sciences can be given in a school to perfection, and with definite assurance that each and every boy receives such instruction. The industrial school cares for the boy or girl during the wasted years and if properly conducted should help the boy or girl to choose a trade more intelligently and place him, or her, in that trade with no inconsiderable amount of preliminary training.

On the other hand, the industrial or trade school cannot *perfect* a boy either on the manual side of his art or in a knowledge of the shop processes and details of manufacture peculiar to his chosen calling. It can supply fairly well the middle field of Fig. 1 but can never give the boy the full training required in the field on either side. It is true that there are a few trades so simple that *trade schools* may educate boys to a point where they are fit to take their places almost at once in the ranks of finished workmen; but these are rare, and in practically all cases the graduate of the trade school must be adapted to a greater or less extent before he is fully efficient in the shop.

Combined Training Systems

It would seem, then, that neither apprenticeship systems or vocational schools, as at present contemplated, can successfully fill the requirements of the industrial field. If, however, there were some way of taking advantage of the good points of both the question could be solved. An effort to accomplish the end is found in the so called Half-Time and Coöperative Systems, under which the boy obtains his practical instruction in the shop and his academic training in the school, special arrangement being made between the manufacturer and the schools for this purpose. Undoubtedly, the idea has many merits; and where operated within its natural limits and in a suitable environment will produce good results. It is limited in its application, however, and cannot be considered a solution of the greater and more general problem. There are many manufacturing districts, on the one hand, which have not and cannot well have the necessary school facilities to operate such a system; and there are many schools so situated as to be unable to obtain the necessary coöperation of manufacturing interests. It has the further drawback of placing the school more or less under the control of private interests, thus leaving no assurance that the training offered will continue to be as broad as would be insisted on in schools entirely under public control. It is almost self-evident that in any public-school *system* the school control must be paramount; and the interests of education and those of manufacturing are far from being always harmonious.

In considering the advantages and limitations of these coöperative courses, the general ideas conveyed in Fig. 1 must be kept in mind. If the school is for the purpose of training mechanics, toolmakers, foremen, etc., the acquirement of manual skill should be a prominent feature of the shop work. If, however, the object be the training of men for the higher levels of the engineering field the shop instruction should lay more stress on the finance of production and the discussion of shop methods, and less on the acquirement of manual skill. The writer appreciates very fully the value of shop skill and the desirability of a long course of training in actual shop work, both for their intrinsic value and for the beneficial influence of the latter on the young man's outlook toward shop men and shop methods. But in the highest grades of technical schools in this country, with curricula containing little more than the bare fundamentals of the scientific side of engineering necessary to give the graduate a good foothold in the field, the *average* graduating age is about 23. This is about as late in life as a young man should be allowed to remain in college. The addition of a long course of shop work to these curricula can be accomplished only in one of two ways; namely, the lengthening of the college course or the reduction of the scientific background, both of which are extremely undesirable. Such shop training as is given must, therefore, lay stress on the finance and methods of production rather than on manual skill, which is of secondary importance to this class of men. The fundamentals of the finance of manufacturing can be given in the class room better than they can in the shop; and it is not necessary or possible for a young engineer to acquire a full knowledge of shop processes by actually performing them.

Manual Aptitude Is Not Necessarily Indicative of Engineering Ability

Furthermore, while, as before stated, I fully appreciate the value of actual shop work, I do not believe that a boy's attitude toward shop work can, or should, be taken as a criterion of his value as a prospective engineer, as some advocates of the coöperative method would insist. The fact that a boy is fond of shop work is just as often a sign that he is not fit to be more than a mechanic, as it is a sign to the contrary. No less an authority than Carroll D. Wright, in discussing modern apprenticeship systems, says: "In so far as the apprenticeship system does not over-emphasize academic instruction, and there is no evidence that it ever will, it will offer great inducements to the boy who does not want to study." All teachers in technical colleges are familiar with the boy whose parents think him an embryo Edison or Steinmetz because he is fond of tinkering at practical work; and who cannot understand why he is found to be unfit for an engineering course simply because he cannot understand mathematics and physics. On the other hand, some of the brightest and best engineering students of the many hundreds who have passed under the writer's observation and who have made marked success in engineering, were not only hopelessly unskilful with their hands, but had little

liking for actual constructive work. High mental development along scientific lines does not necessarily coexist with manual skill and shop leadership; and the high-grade engineer *must* possess the first though not necessarily the two last.

The problem which confronts industrial education for the lower grades is, after all, exactly the same as that which confronted the higher technical schools when they began; and their experience is not only a valuable guide but also an indication of what will most probably be the solution of the problem.

The Higher Technical Schools Are Not Failing to Fulfil Their Purposes

It has not been shown, as yet, that the higher technical schools are not fulfilling their purposes fairly well at least. True, they have many faults, few human institutions are devoid of them, but they have remedied many of these and are improving every day. The fact that they persist; that the better ones are crowded with students who readily find places in the field; and the fact that new ones are being organized daily would seem to indicate that they were in a measure successful. At least we no longer think of training men for the higher positions in the field of law, medicine, engineering, etc., by means of the apprenticeship system. This is not because they cannot be so trained but because it is more *economical* to do it in the modern way.

Now, most of the higher-grade technical schools started out to train men so that they could be introduced into the field at high levels, as indicated at *U* and *V*, Fig. 1, and fill places at those levels without further experience or preparation. This idea still lingers in the degrees which they continue to confer. The awakening of the technical schools from this pleasant dream was a rude one indeed and their attitude on this point did much harm to the cause of technical education. The reason why these schools could not accomplish their purposes was because of the same limitation that has been discussed with reference to industrial schools of lower grade; namely, their inability to give the graduate sufficient training in the right- and left-hand fields of Fig. 1. As a result they have had to recede from their first position, which was analogous to that of trade schools, of high grade, and content themselves with turning out men well trained in the *fundamentals* of engineering science and with what manual skill and manufacturing knowledge it is possible to impart in the time allowed and the facilities at hand. There is a steady movement among the technical schools away from the giving of special courses and special degrees as indicating special training, and toward the teaching of the fundamentals, and it has been found that the men so trained make first-class material to be "adapted" to the varying conditions of the industrial field. The curriculum of Sibley College, for instance, permits of a very limited degree of specialization, being devoted largely to instruction in fundamentals. Yet its graduates are successfully filling positions in almost every part of the upper portion of the field. And this is the common experience of colleges of a similar rank.

The Precedent of Apprenticeship for Technically Trained Men

Many manufacturers alive to the merits of technically trained men have organized so called apprenticeship courses for the purpose of adapting these men, who are trained in *fundamentals* principally, to their particular industry. Graphically, these schools send a man into the field at *P*, say, equipped with the fundamentals *Q R*, *R S* and *S T;* and the manufacturer trains him in the remainder of his requirements *P Q* and *T Z* which constitute the *special* features of his business.

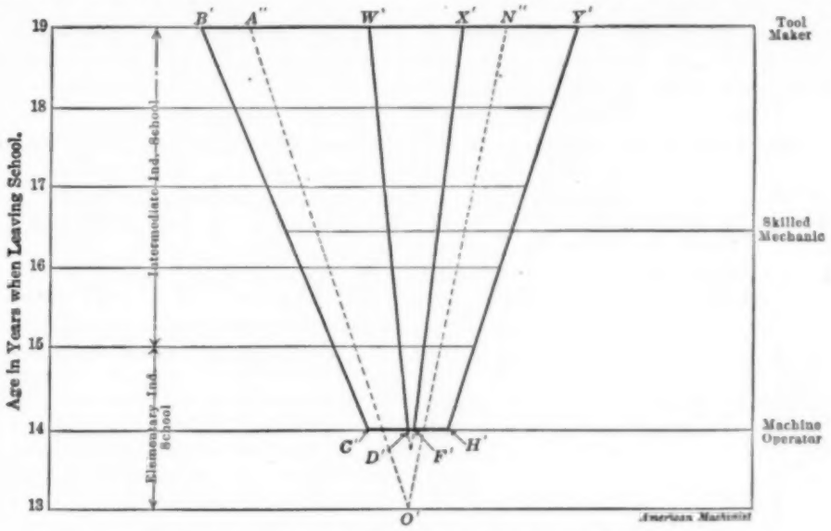

Fig. 2. Diagram of a System of Industrial Schools

It would seem that a similar proceeding farther down the diagram would solve the problem in some measure at least. Few manufacturers can have well developed apprenticeship systems like that of the General Electric Company, at Lynn, but all can do considerable adapting if furnished with good material. This material cannot be trained in the ordinary school any more than embryo engineers can be trained in classical colleges; and the problem requires the remodeling of our lower-grade schools.

A System of Industrial Schools

Much thought and considerable experimentation have already been put upon this interesting and important work; and such experimental schools as have been organized, though not as yet forming, anywhere, a complete system of schools, have indicated some of the possibilities.*

There seems to be no reason why *elementary industrial schools* cannot be organized almost anywhere, in which elementary manual training and industrial fundamentals of *surrounding industries* may be taught in addition to such general education as is needed for intelligent citizenship. Such schools should receive pupils not earlier than the thirteenth year and the course could be two years in length. These schools should be followed by what have been named, *intermediate industrial* schools which might carry the boy or girl to the age of 19 if it proved possible to hold them that long. The first two years in this school would be devoted to the scientific and practical *fundamentals* which underlie a *group* or *groups* of allied industries. The last years could be more closely specialized and partake more of the nature of trade-school work. By such a system a natural sorting process could be maintained and the boy brought closer and closer to the requirements of the industrial field.

Such a system would relieve the manufacturer of a part of the burden which at present is too heavy for many; and at the same time would not burden the public with so heavy an investment as would be necessary for a complete system of trade schools. Such a system of schools is shown graphically in Fig. 2. Here the requirements of the toolmaker, the most highly skilled mechanic as indicated by the line *B Y* in Fig. 1, forms the upper boundary of the diagram in Fig. 2. The lower line *C' H'* in Fig. 2 is the same as *C H* in Fig. 1. The total hight of the diagram, Fig. 2, is six years instead of three years in Fig. 1. The scientific background (*W X* in Fig. 1 and *W' X'* in Fig. 2) is the same in each case; but the amount of practical training which may be given in Fig. 2 as indicated by the dotted lines brings the student very much closer in line with the requirements of the field.

These intermediate schools would not

*See the "Factory School of Rochester," by G. M. Forbes, published by the Society for the Promotion of Industrial Education, New York branch.

prepare for higher technical schools but for industrial life. The writer is well aware that a strong sentiment prevails, particularly among school men, that all schools should lead to something higher and be "open at the top." While he is heartily in sympathy with the sentiment, he can see no sense in keeping schools open at the top for those who cannot enter at the bottom of the school next higher up, *or who have no desire to enter*. The present system of elementary schools is very unjust as far as the great majority is concerned for it fails to provide the training absolutely necessary to give most boys and girls a start in life.

The great majority must work at industrial pursuits and the parents of boys and girls may be trusted, in general, to do the best for them educationally as far as their financial means will permit. A few boys may be deflected through these industrial schools into the field, who should have had greater advantage. For these the continuation school and evening schools, which must be established to supplement the industrial schools discussed above, will afford the opportunity to rise if their ambition warrant it and they will have the ability and training to earn the money necessary for their further development.

The greatest difficulty in the way of these schools or in fact of any system of industrial schools of the lower grades will, no doubt, be the financing of them so that students may be held in school long enough to receive any real benefit. It may be that in the latter years at least, of such courses students will have to be given a chance to work on real productive work in order that they may earn as they learn. We have good reason to believe that even this is possible.

It must also be kept in mind that there is not one fixed way alone of accomplishing the desired result. The question is not, *can* it be done *this* way or *that* way but how can it *best* be done. In many places half-time schools may be successfully organized; in many others peculiar local conditions will make a trade school desirable; but the *general* solution of the problem must be by means of public industrial schools where such fundamentals are taught as will prepare boys and girls for the industries of a large surrounding territory.

And finally it must not be forgotten that the aim and end of all education should be to train men to *think*, not only with regard to their occupation in life, which may be very narrow, but also with regard to the broader industrial problems of the day which surround and intimately affect him, and which at present he is often blindly seeking to solve. The instruction which will help to enlighten the industrial worker regarding these problems, lies almost entirely without the three fields of Fig. 1, though it is closely interwoven with them. Training for manual skill and in shop methods does not help to make a man an intelligent voter; no more does the study of the higher sciences give the broadened outlook and sympathetic view of his fellow men which belong to the truly cultured man. This broader instruction which makes for better citizenship cannot be well imparted in any shop school or apprenticeship system and if every worker is to receive that proportion of such instruction which should by right belong to him, it can come only through some form of organized public instruction which it is hoped will eventually come.

Oxy-Acetylene in Metal Working

By A. Cressy Morrison*

Principles on which the gases work and the dangers that should be overcome, by correctly designed apparatus, before using them. The necessity of a flash-back preventer on the blow pipe. Apparatus for generating gases and ease of obtaining them in storage tanks or bottles. Also their utility.

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The oxy-acetylene blowpipe represents the extreme refinement of a well known principle. Combustion is really rapid oxidization. If we put a blower in front of a coal grate, we force more air directly through the fire. The air contains oxygen, which causes the fire to burn more fiercely and give a greater heat. If we take ordinary city gas and by the use of a Bunsen burner, mix it with large quantities of air carrying oxygen, we get a flue flame of higher temperature.

In both cases, the air that we blow through the fire contains only one part of oxygen to four parts of nitrogen. This nitrogen has no effect upon the combustion, but it has to be heated up and takes heat away with it. Therefore the flame is not nearly as hot as it would be if the nitrogen could be eliminated.

Chemists and engineers have long known that where pure oxygen is used to stimulate combustion, very high temperatures are reached. Oxygen and hydrogen when burned together produce a flame temperature that is remarkable—approximately 4000 degrees. When oxygen and acetylene were burned, a temperature of 6300 degrees Fahrenheit was produced, and this has for a rival only the crater of the electric arc.

It was immediately apparent that if this flame could be controlled the metal worker would have a new tool by means of which he could accomplish results hitherto impossible. If a girder was to be cut, the oxy-acetylene flame would literally burn it apart. If the two parts were to be joined together, the oxy-acetylene flame would, with the addition of a little metal of the same character, melt it together. Later developments of the mechanisms have made the oxy-acetylene flame available for all metal-working establishments.

Acetylene Apparatus

The use of acetylene for country illumination for ten or twelve years has led to the discovery of successful and safe methods of generation. The development of the house-lighting generator was accompanied by a most rigid and carefully prepared set of rules and regulations devised by the National Board of Fire Underwriters. Under these rules all generators must be submitted to the Underwriters' laboratories and there subjected to the criticism of the engineers of this august body before they are classed by the national board as "permitted" machines. The unpermitted generator may, with certainty, be said to contain elements which have in the past caused trouble.

The oxy-acetylene industry, therefore, had successful and perfect mechanism for the generation of acetylene, already prepared for it, the fundamental principles being already well established and the practice good. It was necessary, however, to add to the foundation already laid a means of delivering acetylene to the blowpipe at varying pressures up to 15 pounds to the square inch, but never above.

The necessity of delivering acetylene at the blowpipe under pounds pressure instead of ounces, as in the house generator, involves two principles. One is known as the pressure generator, wherein the acetylene produced in the generator compresses itself as the reaction progresses. The other means of compression is by the use of a pump or blower. In addition to these two methods, a third has a wide utility, especially for temporary plants or where movable units are required, and this is the use of cylinders into which acetylene is compressed in asbestos and acetone, similar to the Prest-O-Lite tanks for automobiles, but a larger size to meet the requirements.

Dangers to Overcome

It is extremely important to point out

the fact that the simplicity of the reaction between calcium carbide and water, accompanied by the instantaneous and copious production of acetylene has, in the house illumination field, tempted the inexperienced to manufacture generators which experience has proved to be defective and sometimes dangerous.

Mechanical engineers of great industrial establishments have undertaken the production of pressure generators for their own purposes. With but a partial knowledge of acetylene and its individual characteristics, they have set these generators in operation in their own plants. There are difficulties and dangers that no mechanical engineer could foresee unless he is a thoroughly trained acetylenist and familiar with the world's experience.

Experiments in this direction should be most earnestly discouraged. There is one fact regarding acetylene that most mechanical engineers overlook.

Almost every gas with which they are familiar can be compressed to liquefaction without changing its character in any way. Carbonic acid gas, oxygen, etc., can be compressed into cylinders, and while certain precautions have to be taken to protect the cylinders from chemical reaction or the results of excessive strains, the gas itself is just as safe, aside from the pressure, as it would be fully expanded. Acetylene under any pressure up to 15 pounds to the square inch, is non-explosive and if subjected to an electric spark, in a pure state and without being mixed with air, cannot be ignited. Oxygen is as necessary to its combustion as it is to any other substance.

If, however, acetylene is compressed beyond 15 pounds to the square inch, its character changes. The dissociation of one molecule will produce the dissociation of all the molecules. Without going into the chemical reasons for this, it is sufficient to say that if acetylene is compressed beyond 15 pounds to the square inch and the temperature in any part of the cylinder or piping reaches approximately 500 degrees Fahrenheit, dissociation will take place and the pressure developed will be sufficient to destroy any cylinder, and experience has shown very disastrous results to buildings in which such explosions have occurred.

Acetone

It is for the above reason that all the pressure generators for use in oxy-acetylene blowpipe purposes are limited to 15 pounds per square inch and the utmost pains are taken that the safety valves shall operate at 15 pounds beyond peradventure. To store it at greater pressures cylinders are first filled with asbestos. After this the air is pumped out, leaving 80 per cent. of free space in the cylinder, and acetone is sucked in in a certain proportion.

It is said acetone has the peculiar property of absorbing 25 volumes of acetylene for each atmospheric pressure. When acetylene is compressed into a cylinder so prepared, enormous quantities can be held in a very small space in perfect safety. An explosion cannot be propagated through the asbestos.

Thus it can easily be seen that the mechanical engineer who is not familiar with the peculiarities of acetylene under pressure might be tempted to make a pressure generator in which the pressure would be created by the volume of acetylene produced. Unless he knew the accepted and safe methods, he might have acetylene beyond 24 pounds to the square inch and the possibility of hot carbide in direct contact with it. Such a generator is known to acetylenists to be inherently dangerous. There are also several other apparently simple principles that have been abandoned as experience has shown them to be impracticable.

The cautions I have given are simply intended to discourage well intentioned but misdirected effort until the whole subject has been mastered, as the difficulties and dangers have already been overcome.

Oxygen

The production of oxygen is developed by two means, one mechanical and the other chemical. Various substances are known to yield oxygen under conditions of varying temperature and proprietary combinations of chemicals are also upon the market with full directions for its production. Methods of generation have been successfully developed and are in operation.

The mechanical production of oxygen is based upon the production of liquid air and fractional distillation by which the oxygen is separated from the nitrogen. The oxygen is then compressed into cylinders and an adequate supply of these cylinders is now upon the market.

Thus the production of the two elements—acetylene and oxygen—necessary for the oxy-acetylene blowpipe have been brought into a practical state in which the metal worker can readily find a constant source of supply of these two elements. The production of calcium carbide has reached a point that places the American product in the front rank and it is instantly available everywhere.

The Blowpipe

The blowpipe itself, in which the mechanical mixing of the oxygen and acetylene takes place, has been more and more perfected, until today it meets practically all requirements. In the blowpipe there are several kinds of devices that will prevent the flashing back of the flame into the acetylene generator. This will prevent the oxygen from forcing its way into the acetylene generator and causing an explosion, in case the blowpipe is suddenly stopped, etc. This again shows that the principle has been worked out and it is unwise for those not familiar with the subject to endeavor to produce a successful blowpipe.

The quality of hose that is required to stand the pressure, the location of the generator and all those phases of the subject are now governed by favorable rules and regulations so that the oxy-acetylene industry rests upon a substantial basis, and this new and wonderful aid to every metal-working establishment, repair shop, foundry and many manufacturing institutions, is available and practically at hand.

Utility

Every superintendent has his own problems to solve. If, for instance, riveting machines are running day and night and joining together sheets of metal, two questions will arise. First, can these two pieces of metal be joined by means of the oxy-acetylene blowpipe—that is, autogenously welded; and second, what will it cost in comparison with the present method? The answer to the first is simply that it not only can, but is being done, and on a very large scale. The answer to the second is that the weld is sometimes accomplished with a great saving over the older processes, but in some cases it will cost more.

If the cost proves higher, the question arises: Are there compensating advantages in the saving in weight of metal; a better joint or less imperfect joints, which must be repaired before the finished piece is sent out? This is answered by the fact that the multitude of advantages which result from an autogenous weld often not only overcome the increased cost but give a trade advantage that is priceless. In one case over a mile and a half of autogenous weld is made daily in a single establishment.

It has been found that most metals can be successfully welded. There are, of course, difficulties encountered, and some things are so far impossible. It is useless to go into detail regarding these failures, as it is equally useless to prophesy the wonderful developments of the utility of the oxy-acetylene blowpipe in the future. It is enough to say that anyone, familiar with metals, can soon satisfy himself as to its utility if he will take the trouble to investigate the subject by putting himself in touch with the manufacturers of apparatus, on one hand, and metal workers who are using it on the other. No superintendent is justified in jumping at the conclusion that it cannot be made available to him. If not available at present, the developments of the future may soon make it so.

There is a tendency in too many cases, to consider only maximum or minimum, rather than average conditions. It is better to sacrifice a little time or convenience on the occasional job, to secure the best results on the average work.

Standardizing the Press Room

By C. A. Thompson

How a lot of punch presses of various sizes and styles were arranged to provide uniform working clearance between ram and bed. The adapters and bolsters used and the standardized form of subpresses adopted for the department.

A convenient celluloid templet for laying out press tools. Some points on subpress tool design and construction.

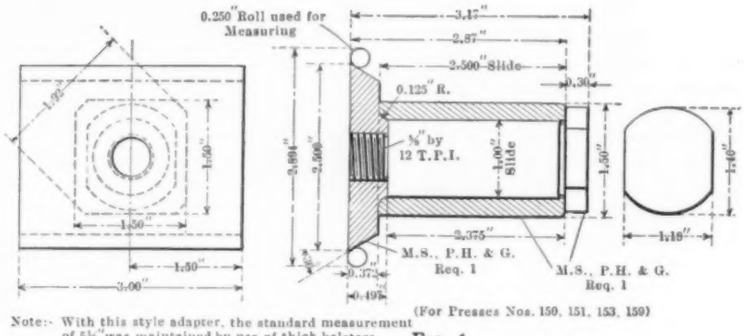
Anyone who has had to design punches and dies for a press room in which there were a number of different sizes and styles of presses, all varying in their dimensions for stroke clearances and adjustments, knows how much time is lost through the draftsman having to measure the press, and lots of times having to strip down some job to do so. If the necessary data are at hand, the drawing has a note: "Use on Press No. so-and-so." This means delay, as lots of times "Press No. so-and-so" has more than it can handle, and other presses are idle. All this can be avoided, along with several other troubles, by the following scheme, which has proved satisfactory.

Preparation of the Presses

I had a room where thirteen different styles and sizes of power presses and three sizes of foot presses were in use. Of course on some styles there were several alike.

The first thing which I did was to find the press which had the least amount of room under the ram when down. I had the adjustment about two-thirds of the way up so as to allow good working conditions. The result was that I could, by facing two-tenths inch off one ram and one-tenth inch off another, get a working clearance between the ram and the bed of the press of 6¼ inches on the smallest, or 5⅛ inches with a one-inch bolster.

Now the next move was to bring all the other presses to this dimension when the ram was down, and the adjustment in the best condition according to judgment. This I did in two different ways. One was by thicker bolsters and the other by the adapters I used.



Note:- With this style adapter, the standard measurement of 5⅛" was maintained by use of thick bolsters.

FIG. 1

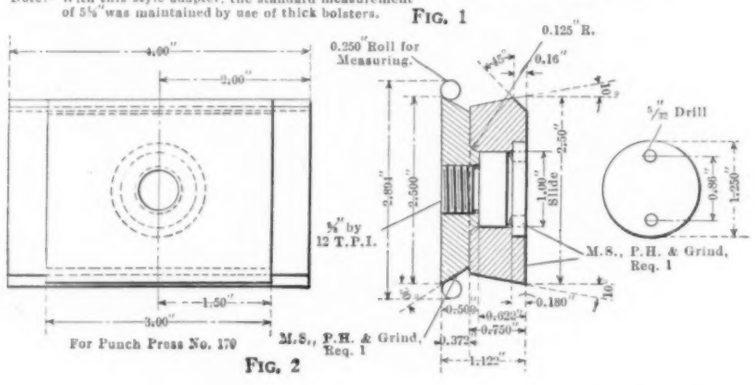


FIG. 2

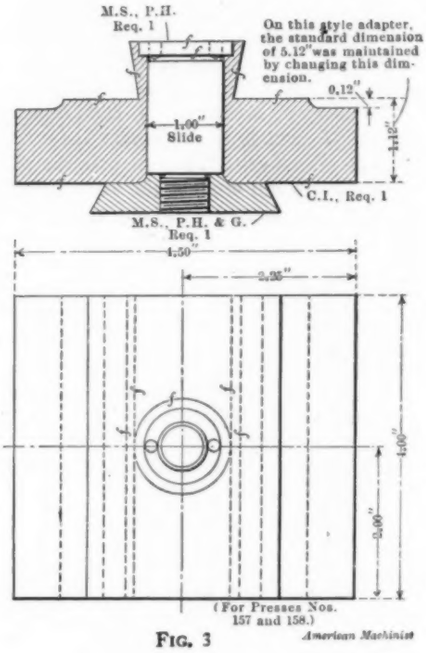


FIG. 3

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ADAPTERS FOR THE PUNCH PRESS

The Adapters

These adapters are of three styles, as shown by Figs. 1, 2 and 3, and it will be seen that they can be altered to bring the V-shaped plate to any hight to suit. It will be seen also that the V-shaped plate is made so it can be swiveled to any angle without removing from the press or loosening the screws for clamping it in the press. Each adapter is considered as part of the press and is stamped with the press number so as to avoid using it in the wrong press.

Now with the adapter in place, each press has the same clearance and all that is necessary to do is to place the job in any press, provided the press will carry the job.

Forms of Subpresses

In making the punches and dies, the pillar subpress style was adopted, as the time saved in setting up and the longer life assured by the perfect alinement more than pay for this style above the common open punch and die. These we made in several sizes and styles, two of which are shown in Figs. 4 and 5. The style in Fig. 5 is used mostly for bending, and in foot presses when freedom of loading is required. The slot for the V-block was made to a gage to insure the V-block fitting snug and allowing of no play. The punches and dies were always machined in 6 or 12 lots to cheapen the labor cost. One of the guide pins is slightly larger than the other, to avoid putting together wrongly.

The Use of Templets

For use in the drawing room in laying out punches and dies, we have celluloid

templets made, one for each size. These are cut out and have a center line scratched on. They are marked with the style of punch and die, the pattern number of the castings, the depth of die surface, and the stroke allowed, in all cases.

The templets assume the stroke as one inch. It does not matter if the stroke is more or not, but by allowing one inch, it makes a good clearance on the drawing between the bottom of the punch and the top of the die. These templets are a great help, as they save time and avoid errors.

Fig. 6 shows a templet. The heavy lines denote the edges to be traced or penciled on the paper. They give the distance between pins, clearance from bottom of plunger to top of base, and the thickness of plunger and base.

Spring Pads

Another trouble which I find in the press room is in connection with spring or rubber pads for bending disk and compound subpresses. These are usually made as part of the punch and die, thus adding to the cost of each tool, and are a source of lost time and trouble when the job is set up.

Fig. 7 shows an adapter fitted to a compound subpress which has overcome all this. It consists of a spring pad fitted to a bolster plate and can be left in the press at all times unless when blanking the blank is too large to pass through the spring pad, in which case we change the bolster. The adapter is arranged so the spring pressure can be increased with ease by simply turning the large screw sleeve.

It can be seen that the opening through the sleeve is shouldered. This allows of putting a disk across to act on the plunger pins that are flush with the bottom of the die.

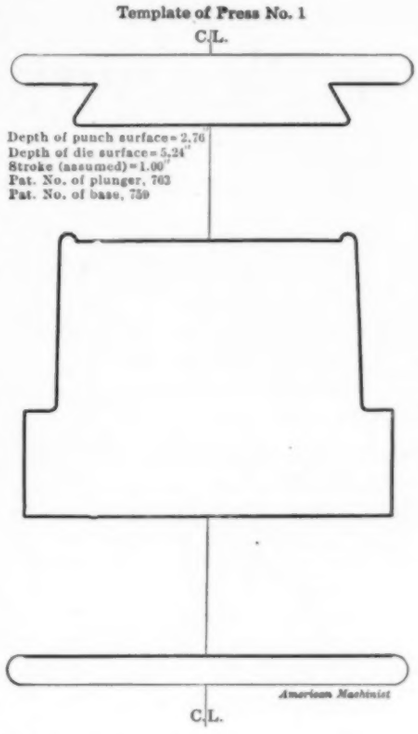


Fig. 6. Celluloid Templet for Press Tools

Stripper Screws and Pins

In making compound subpresses the old method of using several little springs around the edge of the stripper is done away with, the stripper screws are made long enough to come through, and the heads rest on the disk.

The disk across the hole allows the use of pins with shoulders to prevent

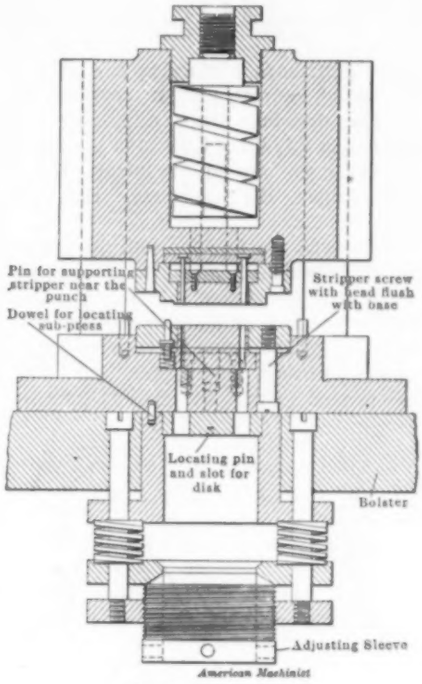

Pin for supporting stripper near the punch
Dowel for locating sub-press
Stripper screw with head flush with base
Locating pin and slot for disk
Bolster
Adjusting Sleeve
American Machinist

Fig. 7. Subpress

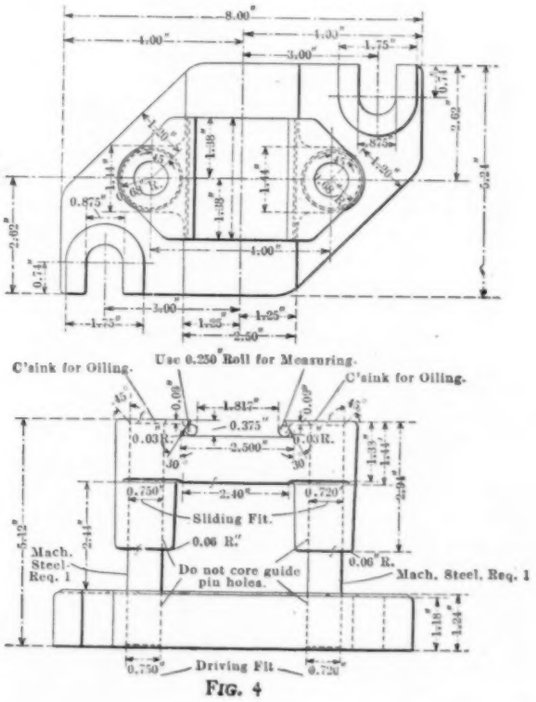


Fig. 4

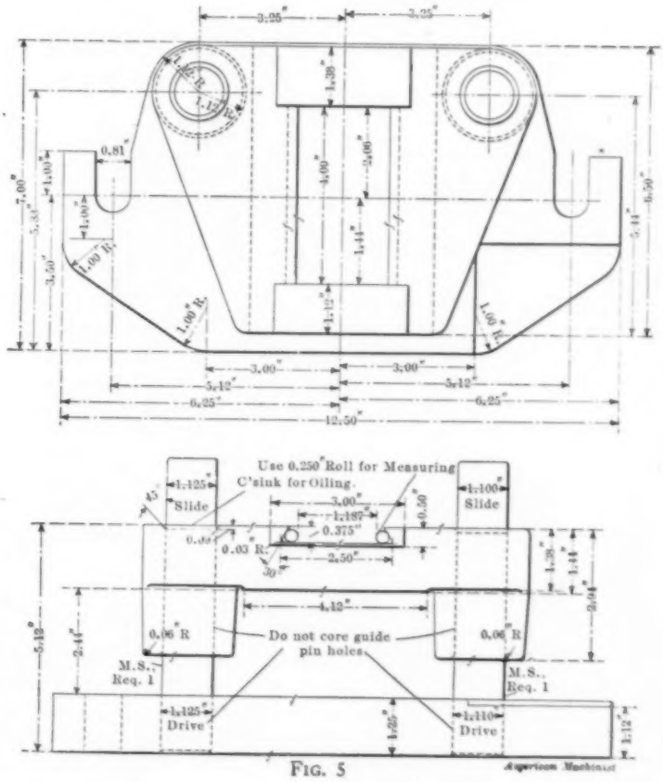


Fig. 5

Subpress Dimensions

their falling out. Being placed near the punch, these pins are used to support the stripper and prevent it from springing in the center, causing it to bind on the punch and in time breaking it. The disk has holes through which piercings can pass, and is positioned by a small dowel in the upper edge of the sleeve and a slot in the disk.

A small dowel is placed in the top of the sleeve, to assure the subpress being located in the proper position in relation to the spring adapter. It will be noted in the drawing that the stripper is made rather thick, which allows for grinding the stripper and punch when sharpening in the same manner as the die and shedder and means that the trouble of adjusting the small spring each time the punch is sharpened, as in the old style, is done away with.

Forging Auger Bits with Helical Dies

Special Correspondence

Methods of forging the helix by means of dies in the helve hammer.

Pointing; upsetting and forming the spur with bolt header.

Cuting the conical screw-point thread with circular cutter.

Novel methods of forging are always of especial interest, and the accompanying line drawings show some unusual methods in this line of work, in the making of auger bits in the plant of the Ford Auger Bit Company, Holyoke, Mass.

Those who are familiar with the ordinary, old-fashioned methods of forging auger bits, are aware that this process usually consists in winding the hot rod, out of which the auger bit is to be made, around an arbor, thus forming the helix. As opposed to this, the method here illustrated is to use dies in a helve hammer, Fig. 1 representing the dies. From this drawing it will be seen that a cylindrical opening through the dies is crossed by three partitions set at the angle of the helix of the auger. The helix is formed by rotating the heated rod in the dies as the hammer is operated, screwing it in and out of the thread in the dies. The result of this first step is shown in Fig. 2, the right-hand end being a short, left-over portion of the helix.

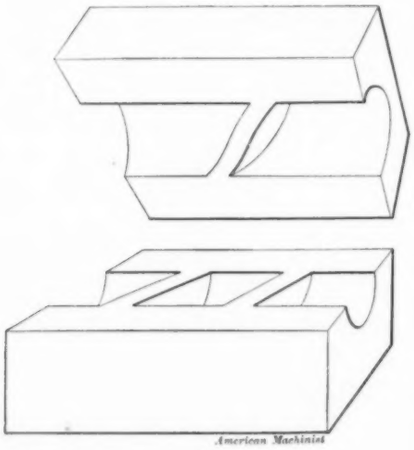


FIG. 1. THE HELICAL DIES

For large sizes; that is, for helixes above an inch in diameter, the next step is shown in Fig. 3. This pointed end is produced by reheating the cylindrical end of the piece shown in Fig. 2, and rotating it between wedge dies, in a helve hammer. About this time the upper, or driving end of the auger, is made central with the helix, by heating and rotating between centering dies. The driving head also is formed between squaring dies.

After forming the conical point, the next step for the large sized augers is shown in Fig. 4. This heavy cylindrical end, with the tip, is formed by reheating the piece shown in Fig. 3, and upsetting it in a bolt header equipped with proper dies. In the case of small auger bits, say up to 1 inch diameter, the second step is that shown in Fig. 5. This is simply a flattening out of the cylindrical end shown at the right in Fig. 2, the work being done between dies which, at the same time, form the tip. By this operation sufficient metal is brought into the right space for forming the end, shown in Fig. 6, which again is done in a bolt header. At this step it will be seen that, not only is the end made cylindrical, but also the cutting spur is formed on the periphery of this cylindrical end. These processes finish the rough forging, the rest of the work being a matter of milling the end and diameter to the required shape and size, and at the same time, putting in the proper amount of clearance. The throat and cutting edges are milled out by hand, on special milling devices, the fine work being done with a file. The entire outside surface of the helix is ground off by rotating across the face of a grinding wheel.

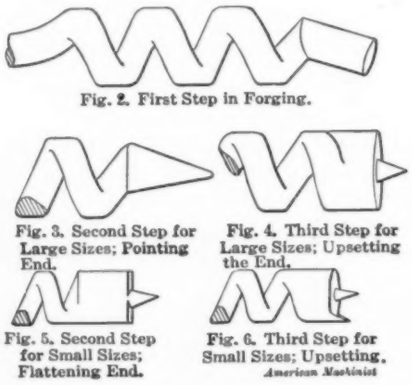


Fig. 2. First Step in Forging.
Fig. 3. Second Step for Large Sizes; Pointing End.
Fig. 4. Third Step for Large Sizes; Upsetting the End.
Fig. 5. Second Step for Small Sizes; Flattening End.
Fig. 6. Third Step for Small Sizes; Upsetting.
American Machinist

STEPS IN THE FORGING

Putting on the conical thread of the cutting tip is an interesting operation, and is performed by rotating and advancing the tip across the face of a revolving die having concentric circular ridges, cut across by grooves to form teeth. This is shown in Fig. 7. The combined rotation and forward feeding of the tip across these revolving circular teeth produce the conical thread usual to the screw point of an auger bit. Hardening, tempering and polishing, finish up the work for the market.

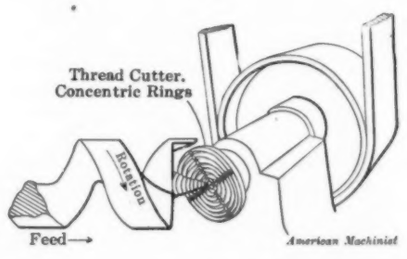


FIG. 7. CUTTING THREAD ON SCREW POINT

Dropping Out of a Clear Sky

A little calculation shows that there was considerable ground for the disturbing thought which persistently lurked in the minds of the spectators who sprained their necks gazing at the aërial stunts in the recent Long Island aviation meet: "What if one of those sky pilots should drop a monkey wrench down on this crowd?"

If, when Johnstone was circling around the blue at 9714 feet above the earth, his monkey wrench had slipped from his pocket, its speed, upon striking the earth would have been just about 500 miles per hour. And it would not have been so long getting down, either; just a little over 25 seconds. It certainly will pay to "duck" in a hurry when, in the future, we see any signs of a monkey wrench rain from a clear sky.

Hardening Steel with Electricity

By E. F. Lake

The different methods by which electricity is used for heating steel to harden and temper it. The electrically heated barium chloride furnace in the General Electric Company's shops at Pittsfield, Mass.; also the electrically heated oil tempering bath, as well as the other equipment that goes to form an uptodate hardening room.

The details of construction of the barium chloride furnace, method of starting it, kilowatts per hour that are used to run it at different temperatures and the salt mixtures that are best to use for baths that are to be maintained at different temperatures.

The use of electricity for heating steel to harden it, as well as for heating tempering baths to draw the hardness in, is gradually coming into more general use as the heat treating of the steel becomes more and more of a science.

The many experiments and investigations that have been carried on in the past have proved that different kinds of steels must be heated to different specific temperatures for the different uses to which the pieces are to be put. Electricity gives us a method of quickly obtaining certain predetermined temperatures with an accuracy and constancy that are difficult to obtain with most other methods.

Where the question of cost is of secondary importance, electricity is doubtless the best fuel for heating all kinds of steel to any desired temperature for hardening it, as well as for drawing out a part of the temperature after it has been hardened. In many places, when everything is taken into consideration, it might compete successfully with other fuels, from an economical standpoint. Electricity has been used in many different ways for heating the metal, and some of these are not yet past the experimental stage, while others have been made commercially successful.

Resistance Method

The different methods employed are both of the resistance and arc types. One resistance process consists of attaching a positive and negative wire to a piece of steel, and then inserting it into a quenching bath. While the metal is covered by the bath, the current is turned on and heats the steel to the temperature desired. After this the current is turned off and the metal allowed to cool without removing it from the bath.

By the use of transformers, rheostats, etc., the current can be controlled so that the exact temperature desired can be given the metal when heating it. By heating and cooling the steel while it is submerged in the bath, the surface oxidation and resultant scale that are so often met with in the ordinary method of hardening steel can be entirely overcome.

A variation of this resistance method is to place the tool, or piece to be hardened, in a specially constructed holder and connect this up so the tool will form the positive electrode. An iron tank containing a solution of potassium carbonate is then connected up to form the negative electrode. By turning on the current and slowly lowering the tool into the potassium carbonate bath the circuit is formed and that part of the tool that is immersed will be heated to the temperature desired. By turning off the current the solution will then serve as a quenching bath.

Arc Method

The electric arc has been used for heating steel for hardening by employing an insulating block as a table or bench top and placing on this the positive electrode properly connected up to the electrical supply. The steel was then placed on this electrode. A carbon was secured in a safety holder and properly wired to form the negative electrode. By touching this carbon to the steel an electric arc was formed; by moving it around the part to be hardened the proper heat would be given it and the steel could then be plunged in the quenching bath.

Other methods which are being successfully used commercially are those illustrated and described below.

Hardening Room

The General Electric Company in their plant at Pittsfield, Mass., have devoted a good deal of time to experimenting with electricity for hardening and have perfected and placed upon the market a barium chloride bath furnace for hardening and an electrically heated oil bath for tempering. These they are using daily in their tool hardening room, which is shown in Figs. 1, 2 and 3.

The view shown in Fig. 1 was taken from the northeast corner of the room and shows the apparatus down the center as well as the gas-heated furnaces which are located along one side. As will be seen, the furnaces giving off fumes, gas, smoke, etc., are covered with hoods which convey them to pipes, in which they pass through the roof of the building to the outside atmosphere. The piping is shown so plain in this view that it is only necessary to call attention to it for its construction to be seen.

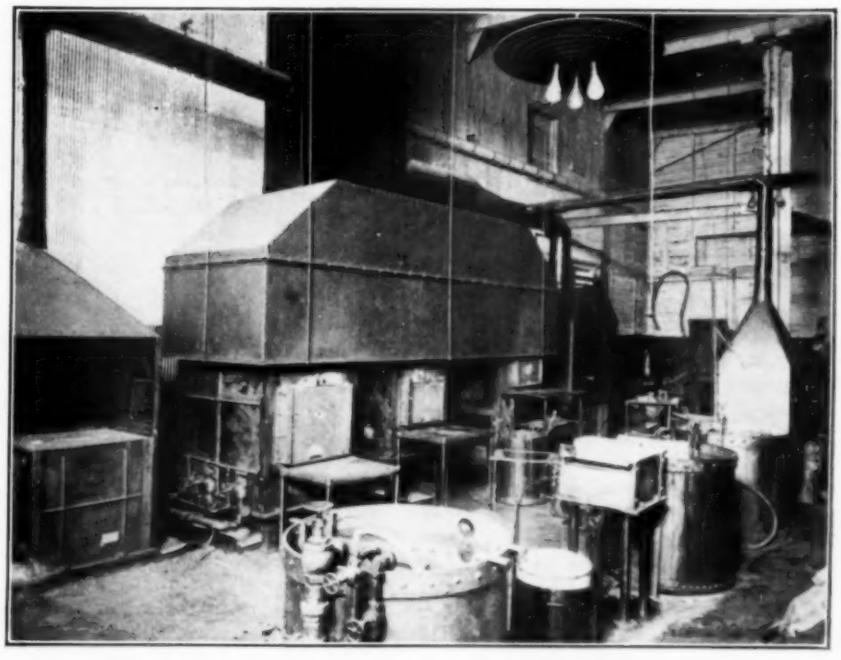


Fig. 1. Northwestern Corner of General Electric Company's Tool-hardening Room, Pittsfield, Mass.

The Apparatus

In Fig. 2 is shown a view that was taken from the southwestern corner of the room. This also shows the apparatus in the center, on each side of which is a gangway. Along the side of the room to the right of the picture are shown the two electrically heated barium chloride furnaces with their transformers and switchboards. One of these is maintained at the proper temperature for hardening carbon steels, and it, therefore, is seldom raised above 1650 degrees Fahrenheit. The other is used for heating high-speed steels for hardening and a temperature of from 2000 to 2400 degrees Fahrenheit is given it, according to the kind of steel that is being hardened.

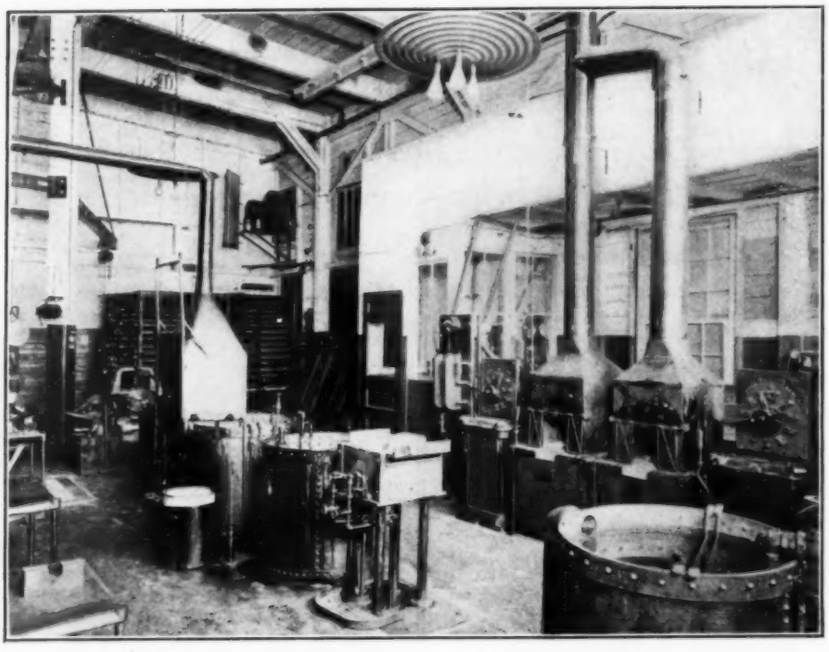


Fig. 2. Northwestern Corner of Tool-hardening Room

In front of the furnaces to the extreme right of the illustration is located a brine bath for quenching the steel, and to the left of these are two tanks that contain oil and water respectively. These baths are all agitated and cooled so that they will maintain an even temperature, and thus give uniform results in quenching.

Between the quenching baths and directly in front of the barium chloride furnaces is located a small gas-heated furnace. Its oven is used for heating small tools, while the top has been arranged for holding steel pieces so they can be slowly pre-heating before inserting them in the barium-chloride furnaces. A chamber has also been made in the top of the barium-chloride furnaces, in which steel can be pre-heated before submitting it to the high temperatures of the bath.

The Oil Tempering Bath

Next to the two quenching-bath tanks in the center of the room is located the electrically heated oil tempering bath. This is shown covered with a hood, with a vertically sliding door in front. In the corner beyond this is a steel rack that holds the stock tool steel, and directly above it is a motor-driven fan which ventilates the room. Between this and the electric hardening furnaces is located an office for the foreman of the hardening room.

Fig. 3. Tool-hardening Room from Northern End Looking South

In Fig. 3 is shown a view of the hardening room that was taken from the north end. In the foreground to the right will be seen the anvil for forging and dressing the tools, while in the center is located the electric tempering bath. To the right of this are placed the gas-fired, hood-covered furnaces that are shown in Fig. 1. To the extreme left of the picture is located the foreman's office, and beyond this an end view of the transformer and switchboard which controls the heat in the barium chloride furnaces; these being located just beyond this apparatus.

Electric Barium Chloride Furnace

While the barium chloride furnace outfit, shown in Fig. 2, well illustrates the principles of operation, its outward design has been perfected, so it will not occupy as much floor space. In Fig. 4 is shown the latest design. This consists of the furnace proper with its hood, sliding doors and preheating chamber; a regulating transformer, that consists of the transformer core and coils which are immersed in oil in a substantial iron tank; a regulating switch that is placed on top of the transformer; a line switch with two fuses that are placed on top of the regulating switch, and a thermoelectric pyrometer that is calibrated for direct reading of the temperature in the furnace and hung from a swinging arm, fastened to the top of the switchboard.

The furnace is run on a single-phase alternating current. One section of the primary winding is subdivided into a number of steps, and taps are brought from these to the dial switch that does the regulating. This switch is provided with 11 points that correspond to 10 steps either way, and thus give 21 adjustments.

These correspond to a range in the voltage, applied to the furnace terminals that varies from that required to keep the baths just above the freezing point to that necessary to start the furnace by the use of the starting electrode.

With this variable voltage it is possible to produce and maintain the bath at any temperature that is desired for hardening the different kinds of steel. To get these different temperatures, however, it is necessary to use the proper kind or combination of salts.

Salts Used in Baths

For producing the maximum temperature so far attainable, namely 2400 degrees Fehrenheit, chemically pure barium chloride ($BaCl_2$ 12) crystals should be used, as well as for all temperatures down to 1800 degrees. In other words, it should be used for all of the higher heat-treating temperatures that are used for hardening high-speed steel.

When temperatures in the barium chloride bath, between 1400 and 1650 degrees Fahrenheit are desired, a mixture of three parts of pure barium chloride crystals to two parts of chloride of potassium (KCl 1) should be used.

Temperatures below 1075 degrees Fahrenheit can be obtained by using potassium nitrite and sodium nitrite in equal parts. This latter combination, however, is somewhat unstable at some temperatures. It will remain liquid at 480 degrees, if left standing, but at 400 degrees it can only be kept liquid by frequent stirring.

Pitting

The trouble of pitting that has been caused by heating the steel to 2100 degrees Fahrenheit or over, in gas-fired barium chloride furnaces is entirely overcome in the electric furnace. In the gas-fired furnace it was necessary to use a graphite crucible, and fill this with barium chloride, and apply the heat to the outside of the crucible. This might cause flakes of graphite to loosen from the crucible, when it was heated to over 2100 degrees Fahrenheit, and mix with the molten chloride, and attack the steel and cause pits.

When, however, the chloride is melted by electricity, the heat is applied to the bath itself, on the inside of the crucible, and hence the walls can be made of any thickness desired. A crucible can thus be built up of slabs of refractory material, cemented together and surrounded by heat-insulating material in a substantial sheet-iron case, as is done with the electrical furnace shown. Then various kinds of clays can be used and no graphite is present to permeate the bath and attack the metal.

Another reason that might be assigned for pitting is that an insufficient temperature was given the chloride by the gas-heated furnace, and when this was not at the proper temperature for the particular class of steel being heat treated, it would act similar to an acid and thus cause blistering.

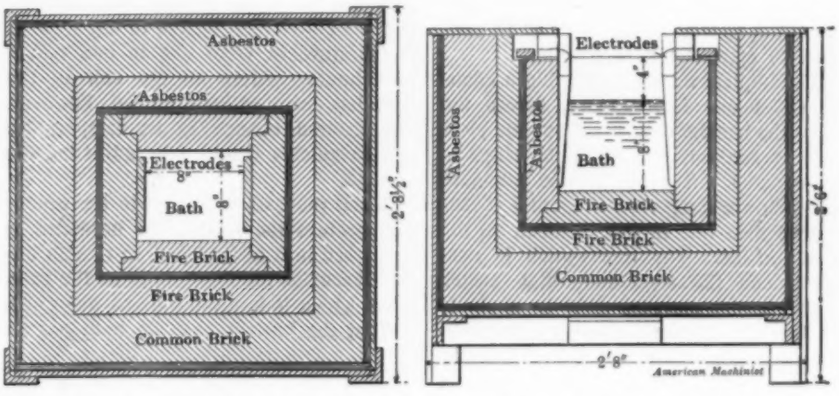


Fig. 5. Sectional Plan and Elevation of Electric Hardening Furnace

Fig. 4. Electrically Heated Barium Chloride Hardening Furnace Outfit

Details of Construction

In Fig. 5 is given two sectional views which show the details of construction of the furnace. The box is built up of sheet iron and angle irons that are riveted together. This is lined with asbestos and inside of it two courses of common brick are laid. One course of firebrick is then laid inside of the common brick, and this again lined with about one inch of asbestos. Inside of this are placed the special firebricks that form the crucible, and they are cemented together with fireclay so that there will be no leakage of the barium chloride when it is molten.

The opening then left is 8x10 inches and 12 inches deep. When the two electrodes are inserted on each side of this opening, it leaves a space 8 inches square for the bath. If the level of this is kept 4 inches below the top of the furnace, an 8-inch cube of molten barium chloride can be obtained.

It is necessary to keep the metal at least an inch away from the electrodes, or the sides of the furnace, and hence a piece six inches square can be heated for hardening in this bath.

The electrodes are made of soft iron, and if the bath is operated at 1400 degrees Fahrenheit, they will last 3000 hours. If the bath is operated at 2200 degrees Fahrenheit, an electrode life of 400 hours is obtained.

This installation is sufficient to run the furnace at 2400 degrees Fahrenheit, and the construction is such that the hand will not burn if rested on the sheet-iron case. This allows a quenching bath to

be placed close to the furnace to avoid cooling the tool in the air any more than is necessary. It also reduces the fire risk.

Starting the Furnace

The salts used for these baths solidify when the current is turned off, and they are then a non-conductor of electricity. Therefore, special means have to be provided to start the bath melting.

The simplest method is to chip a channel about one inch square, across the top of the barium chloride, from one electrode to another, and leave the chips in the channel. A piece of the standard half-inch arc lamp carbon about 7 inches long, is then laid in this channel, on top of the chips. The line switch is next closed and the regulating dial switch turned to the extreme right to apply to the furnace terminals the minimum voltage obtainable. The auxiliary electrode, which is connected to the furnace, is then used to tightly press the carbon

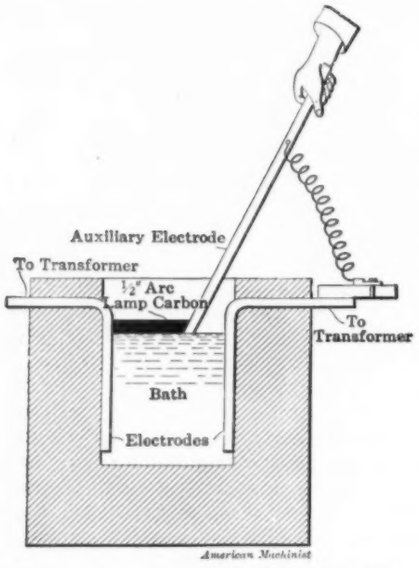


Fig. 6. Method of Starting Furnace

against the electrode on the opposite side, as shown in Fig. 6.

This will start the current flowing and melt the barium chloride chips directly under the carbon, after which the auxiliary electrode should be slowly drawn to the right, and thus melt the salt in the balance of the channel and produce a molten stream from the left-hand to the right-hand electrode. This will start the electrical current through the bath, and the switch can then be rotated to the maximum voltage until the entire mass is in a liquid state. The half-inch carbon can then be taken out of the bath, and the regulating switch adjusted, so that the bath will be maintained at the desired temperature.

Adjustment of Bath

By the proper adjustment the bath can be maintained at a uniform temperature throughout its entire area, except for a depth of about ⅝ inch from the surface. This is more or less affected by the atmosphere, and hence tools should be immersed more than ⅝ of an inch below the surface.

The circuit in the channel can be established in from five to ten minutes, and the entire bath heated to any desired temperature in from one to one and a half hours. After all the salt in the bath has been entirely melted, however, any desired change in its temperature can be quickly obtained by adjusting the voltage.

When the bath is heated to the proper temperature the tool to be hardened is immersed in it and allowed to remain until it becomes the same color as the bath, after which it is removed and quenched.

That the barium chloride bath has no effect on the composition of carbon steel has been well demonstrated, but on high-speed steels there seems to be a tendency for a very thin film on the outside to soften or decarbonize, if the tool is kept too long in the bath, or at certain temperatures. This, however, is of no material difference on tools which are to be ground.

Time and Power Used

The time that is required to raise the temperature of round steel from atmospheric to 1400 degrees Fahrenheit is given in the following table:

Diam., Inches.	Length, Inches.	No. of Pieces.	Weight, Pounds.	Time, Minutes.
½	6	1	0.32	¾
½	6	6	1.92	3
¾	6	1	0.71	1½
¾	6	6	4.26	6
1	6	1	1.27	2½
1	6	6	7.62	8

The switch was not changed when a single piece was heated but when the six pieces were heated simultaneously, the voltage was increased as soon as the metal was immersed and again reduced as soon as the correct temperature was reached.

The power that is required to maintain the temperature of this furnace from 1150 to 2400 degrees Fahrenheit is shown by the chart, Fig. 6. These are the kilowatts that are used in maintaining the bath only at the given temperature, and the results were tabulated after the temperature in the bath had become stationary; no tools being heated in it.

Benefits of Two Furnaces

It will be seen from the curve that the power used for hardening carbon steel is only about one-fourth of that used for hardening high-speed steel. A smaller transformer can therefore be used for one steel than for the other. Both can be heated in a crucible that has the temperature controlled by a large transformer, but a different salt mixture is desired.

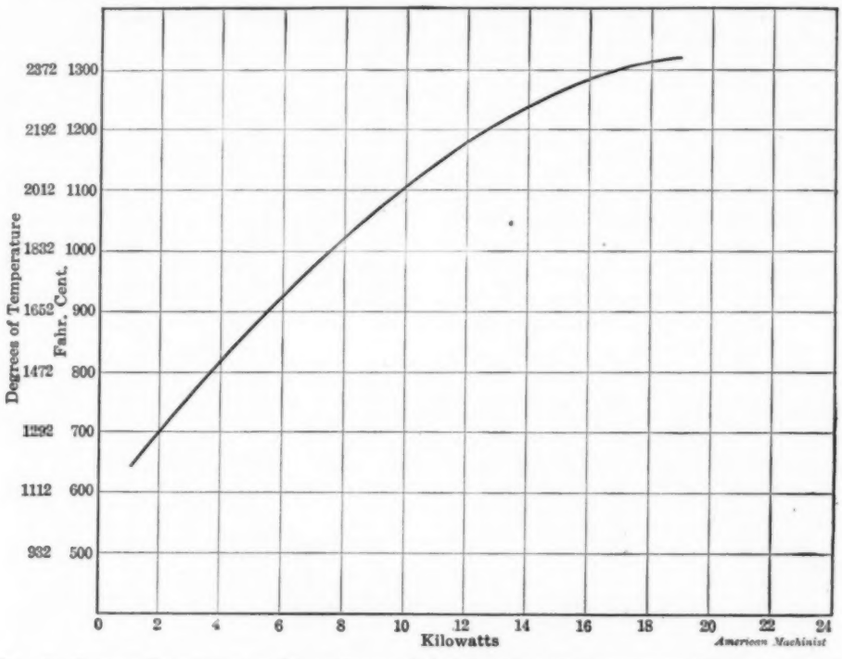


Fig. 7. Power Required to Heat Bath 8x8x8 Inches to Different Temperatures

It is therefore preferable to have two crucibles; one of which could contain a mixture of barium chloride and potassium chloride, for temperatures ranging from 1200 to 1800 degrees Fahrenheit; and the other could contain only the pure barium chlorde, for temperatures ranging from 1800 to 2400 degrees Fahrenheit.

These could both be run from one transformer, and while it might be more economical in some ways, it would not be possible to operate both crucibles simultaneously. Where enough work is to be hardened, it is therefore the best practice to have two complete outfits, one with a

smaller transformer and the other with a large one.

Tempering Bath

The electrically heated oil tempering furnace, shown in Figs. 1, 2 and 3, consists of a rectangular cast-iron tank that has six evenly spaced lugs cast vertically on each side of it. These lugs are drilled so cartridge-type heating units will fit into them, and all parts of the oil bath are thus maintained at an even temperature.

This cast-iron tank is set into another that leaves a 3-inch space on the bottom and four sides. This space is filled with mineral wool so that heat will be retained in the oil bath.

The tank for the tempering bath with the hood removed, is shown in Fig. 8, as it is provided with a thermometer and a perforated basket for holding tools.

These tanks are made in three different standard sizes, as shown in the following table, which also gives the power required to run the bath. They are furnished for either single or multiple heat control.

No.	Length, Inches.	Width, Inches.	Depth, Inches.	Oil, Gal.	Kilowatt.
1	22	12	8	9	6
2	18	12	12	11	7.2
3	30	16	18	37	20

The maximum energy consumption of these baths is sufficient to heat the oil to a temperature of 450 degrees Fahrenheit in less than an hour, starting cold. The maximum temperature that it is possible to obtain is 600 degrees Fahrenheit, as this is close to the flashing point of the oil, and is as high a temperature as is used for tempering any kind of tools.

With this method of tempering it is only necessary to have a table of the temperatures at which it is required to draw the various tools heat treated, or that correspond to certain degrees of hardness in the steel. The operator can then place the work in the bath and bring it to the required temperature, which will be registered on the thermometer. He can then hold it at that temperature as long as is necessary to thoroughly saturate the piece with the heat, and then remove and cool it. Thus work can be uniformly tempered no matter what workman does the work, and the work can be handled quickly and easily.

Drilling Speed and Feed Table

Tables of drilling speeds are always helpful when they represent actual practice rather than speeds and feeds figured out to show what ought to be done.

The figures in these tables were obtained by correspondence with a number of the well known machine-building shops and should prove a very safe guide on this account.

As most of the shops in question do very little brass work, only two shops give definite information in this line. This will, however, give an idea of prevailing practice as a starting point.

We shall be very glad to have further data along this line, and if any reader has found either higher or lower speeds better adapted to his work, we would be very glad to know full particulars in regard to his experience.

On the smaller drills it is sometimes a question of securing the desired speed with the machines in use.

Editorial Correspondence

Drilling speeds and feeds that are being used in every-day work; for both carbon and high-speed drills.

BRASS.

Shop.	Carbon Drills. Speed in Rev.	Carbon Drills. Feed per Rev.	High Speed Drills. Speed in Rev.	High Speed Drills. Feed per Rev.
	One-eighth Inch.			
No. 6	2140	0.007″	4250	0.007″
No. 7	1800	0.002	2700	.....
	One-quarter Inch.			
No. 6	1070	0.009″	2140	0.009″
No. 7	900	0.002	1350	.....
	One-half Inch.			
No. 6	535	0.006″	1070	0.006″
No. 7	450	0.004	675	.....
	Three-quarter Inch.			
No. 6	356	0.020″	712	0.020″
No. 7	300	0.006	450	.....
	One Inch.			
No. 6	268	0.022″	535	0.022″
No. 7	200	0.010	300	.....
	One and One-half Inch.			
No. 6	178	0.0235″	356	0.0235″
No. 7	125	0.010	200	.....
	Two Inches.			
No. 6	134	0.0245″	268	0.0245″
No. 7	100	0.010	150	.....

CAST IRON.

Shop.	Carbon Drills. Speed in Rev.	Carbon Drills. Feed per Rev.	High Speed Drills. Speed in Rev.	High Speed Drills. Feed per Rev.
	One-eighth Inch.			
No. 1	....	.....	1300	0.003″
No. 4	....	.....	1800	Hand.
No. 5	1170	Hand.	1070	Hand.
No. 6	1070	0.0085″	2140	0.0085
No. 7	1200	0.004	1800	.....
	One-quarter Inch.			
No. 1	....	.....	1000	0.003″
No. 4	....	.....	1200	Hand.
No. 5	535	Hand.	535	Hand.
No. 6	535	0.105″	1070	0.0105
No. 7	600	0.008	900	.....
	One-half Inch.			
No. 1	....	.....	375	0.0073″
No. 2	229	0.007″	345	0.007
No. 4	....	.....	600 to 800	Hand.
No. 5	55″	0.013	70 ft.	0.013
No. 6	267	0.018	535	0.018
No. 7	300	0.016	450	0.016
	Three-quarter Inch.			
No. 1	....	.....	275	0.0072″
No. 2	150	0.007″	225	0.007
No. 4	....	.....	400	0.0075
No. 5	150	0.013	300	0.013
No. 6	178	0.0225	356	0.0225
No. 7	200	0.016	300	0.016
	One Inch.			
No. 1	....	.....	200	0.008″
No. 2	230	0.011″	155	0.011
No. 4	....	.....	325	0.0075
No. 5	30″	0.008	60 ft.	0.008
No. 6	133.8	0.025	267.6	0.025
No. 7	125	0.021	200	0.021
	One and One-half Inch.			
No. 1	....	.....	125	0.00937″
No. 2	75	0.011″	115	0.011
No. 4	....	.....	200	0.0075
No. 5	76	0.008	.....	.....
No. 6	89	0.0275	178	0.0275
No. 7	75	0.021	125	0.021
	Two Inches.			
No. 1	....	.....	96	0.009″
No. 4	....	.....	140	0.0075
No. 6	66.9	0.0285″	133.8	0.0285
No. 7	55	0.021	80	0.021

While the term "steel" is a little indefinite, it refers to the average low carbon steel used in manufacturing machine parts. This will, of course, vary to some extent, but will average as well as cast iron.

STEEL.

Shop.	Carbon Drills. Speed in Rev.	Carbon Drills. Feed per Rev.	High Speed Drills. Speed in Rev.	High Speed Drills. Feed per Rev.
	One-eighth Inch.			
No. 1	....	.....	1000	0.003″
No. 4	....	.....	1200	Hand.
No. 5	1070	Hand.	1070	Hand.
No. 6	920	0.0014	1840	0.0014
No. 7	850	0.002	1400	0.002
	One-quarter Inch.			
No. 1	....	.....	650	0.003″
No. 3	450	0.004″	1500	0.005
No. 4	....	.....	800	Hand.
No. 5	535	Hand.	535	Hand.
No. 6	460	0.0042	920	0.0042
No. 7	400	0.003	700	0.003
	One-half Inch.			
No. 1	....	.....	350	0.005″
No. 2	200	0.007″	260	0.007
No. 3	225	0.004	760	0.005
No. 4	....	.....	525	Hand.
No. 5	305	0.010	460	0.010
No. 6	230	0.0072	460	0.0072
No. 7	150	0.004	350	0.004
	Three-quarter Inch.			
No. 1	....	.....	250	0.0053″
No. 2	130	0.007″	178	0.007
No. 3	150	0.007	500	0.008
No. 4	....	.....	300	0.0075
No. 5	102	0.008	230	0.008
No. 6	153	0.009	307	0.009
No. 7	110	0.006	175	0.004
	One Inch.			
No. 1	....	.....	175	0.006″
No. 2	76	0.007″	115	0.007
No. 3	115	0.009	380	0.010
No. 4	....	.....	225	0.0075
No. 5	76	0.008	170	0.008
No. 6	115	0.010	230	0.010
No. 7	75	0.006	140	0.006
	One and One-half Inch.			
No. 1	....	.....	100	0.0078
No. 2	51	0.007	76	0.007
No. 3	75	0.009	250	0.010
No. 4	....	.....	125	0.0075
No. 6	77	0.011	154	0.011
No. 7	50	0.008	75	0.008
	Two Inches.			
No. 1	....	.....	85	0.008″
No. 3	55	0.009″	190	0.010
No. 4	....	.....	105	0.0075
No. 6	57	0.0114	115.6	0.0114
No. 7	30	0.010	55	0.010

Hobbing Spur and Worm Gears

Special Correspondence

How spur and worm gears are cut on the Gould & Eberha dt gear hobber. Suggestions that will be helpful in handling almost any make of gear-hobbing machine.

A framed spur-gear chart is furnished with each machine, on which the combination of change gears is given, for cutting all numbers of teeth from eight to 100 and a large range above 100 to 400. The feed index and diagrams for positioning the cutter and change gears are also given on said chart.

The chart is first consulted to obtain the proper change wheels for the number of teeth to be cut and for the feed. These gears are located and placed in position at the rear end of the machine.

The helical or hob cutter is placed upon the arbor, and a space of the cutter set central by the gage furnished. Setting a space central is very important when cutting gear wheels having a less number of teeth than thirty.

Setting the Cutter

To set the cutter, the nuts on the spindle bearings are loosened and the cutter spindle bearings adjusted lengthwise by means of the small adjusting screw until a space of the hob matches exactly with the gage. The spindle-bearing bolts are securely fastened and the gage withdrawn.

The swivel slide is then adjusted to the proper angle, and marked on the hob; the spur-gear index being first consulted to get the proper position of the cutter in relation to the perpendicular, which depends whether the cutter is right or left hand. The work mandrel is then inserted in the work table and blank securely fastened.

The outer support arm is placed in position and the wheel blank is then tested by an indicator to see whether its outer periphery revolves perfectly true with the hole. The revolving of the blank is accomplished by merely starting the machine with the belt on the fastest speed or by disengaging the worm and revolving the work table by hand. It is very important to have the blank revolve true to obtain good results in the running of the finished gear.

After the wheel blank has been found correct the cutter is lowered so that the center is below the upper edge of the blank. The radial faces of one row of cutting teeth must be parallel with the center line of the spindle. That is, they should be at the highest point in relation to the face of the wheel blank.

The blank is then adjusted until the periphery of the blank just touches the top of the cutting teeth. The cutter is then raised above the face of the blank adjusted to its proper depth to be cut. A dial on the screw reads in thousandths, which is set to zero after the cutter has been raised. The proper depth can then be read, when the blank is adjusted toward the cutter.

Starting the Cut

The machine can then be started and the cutter fed to the upper edge of the work by means of the hand wheel and the feed engaged. The dog on the vertical feed rod is then located so as to disengage the feed when the center of the cutter has passed beyond the lower edge of the wheel blank, when the machine will automatically generate all of the teeth without further attention upon the part of the operator.

The setting of the wheel blank for the proper depth as outlined, should not be relied upon to give the proper thickness of tooth at the pitch line. The teeth should be measured upon the pitch line with a gear-tooth caliper, having previously set the caliper for the chordal thickness and corrected addendum, as given in the tables for the proper number of teeth. This measuring should be done when the center of the cutter has just passed the upper edge of the blank. If it is found that the tooth does not measure correctly, blank should be readjusted.

To Cut Single-thread Worm Gears

When the worm wheel to be cut is to mesh with single-thread worm, the change gears are placed in accordance with the spur-gear chart.

Multiple-thread Worm Gears

Divide the number of teeth to be cut in the worm wheel by the number of threads in the hob or worm and gear up the machine for the resulting number of teeth.

Another method to gear up the machine for worm wheels with the multiple-thread worms, is to use the second compound stud. The gears on the first compound stud should be placed for the exact number of teeth in the wheel to be cut. The gears on the second compound should have a ratio equivalent to the number of threads in the hob.

Example: To cut a worm wheel 67 teeth suitable for a triple-thread worm, the proper gears should be placed on the first compound as given for 67 teeth on the spur-gear chart. On the second compound, a pair of gears with the ratio 3 to 1 (90 into 30) will give the proper number of divisions. It is always well before starting to cut into any gear to allow the hob to just scrape the surface and count the number of marks to make sure that the machine is geared up correctly.

The diagrams on the bottom of the spur-gear chart should be carefully noted when gearing the machine for spur gears or worm wheels. The cutter is then secured to the arbor and the end bearings secured in position.

Adjusting the Slide

The swivel slide is adjusted to obtain the relation that the center line of the worm is to bear to the axis of the worm wheel to be cut. The gears to rotate the cutter in the proper direction are then engaged by means of the handle on the pulley side of the machine. The proper tumbler gears are engaged to obtain the in feed for the work blank.

The work is secured to the mandrel and tested as in spur gears. The cutter is then lowered until it bears the proper relation to the face of the blank, and the blank is adjusted until it just touches the hob cutter. The in feed is then engaged on the front end of the machine. Care should be taken that the down feed is disengaged.

The proper speed for the cutter must be provided for, and then the machine is started. The dog on the horizontal rod can be set to disengage the in feed when the blank is cut to the proper depth. A vernier scale is provded to give the exact distance between the center of the hob and the wheel blank.

Pendular Hardness Gage

Doktor Ingenieur J. Kirner describes, in the *Zeitschrift des Vereines deutscher Ingenieure,* a hardness-testing instrument of the rebounding type constructed in the form of a pendulum. The hammer carrying the striking truncated cone is swung by a rod from a post on a small stand provided with leveling and other adjustments. The bar of steel to be tested is clamped in a vise, presenting its end to the hammer. The hammer is then raised a certain number of degrees measured on an arc-shaped scale, upon which is also read the extent of its rebound. There are pointed out several good qualities in this simple instrument, as namely, that the end of a long bar may be presented to it with little preparation and the hardness determined over the entire cross-section. The hammer is heavy enough to penetrate for some distance into the surface, which does not have to be perfectly flat. The gage is said to be accurate for practical purposes. It is manufactured by the Norma-Compagnie, G. m. b. H., of Cannstatt-Stuttgart, Germany.

Letters from Practical Men

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

Boring Large Taper Holes in a Drill Press

An example of a job done in a shop not equipped with the proper tools, is shown in the accompanying sketch taken from my mental notebook, where it was entered several years ago. It represents the taper boring of the hub of a 15-foot propeller under a 6-foot radial drill press. The work was as good as could have been done even in a machine built for the purpose.

The apparatus, as shown in the accompanying sketch, consists of a boring bar with feed screw and star feed, and differs from the ordinary bar only in that it has one permanent center in one end (the lower in the sketch) and a sliding center block clamped in a dovetailed groove by a gib and set screws, at the other. This block contains the center, and as it may be shifted to any position

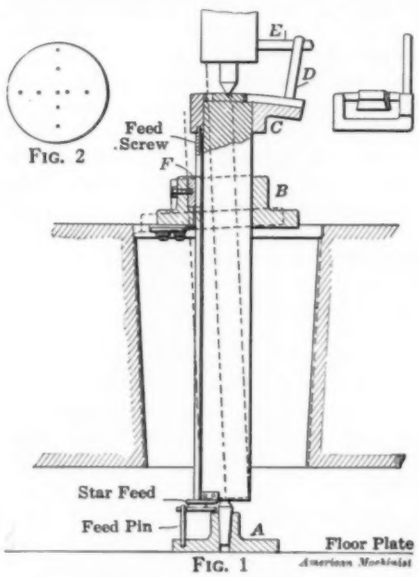


FIG. 2

FIG. 1

BORING LARGE TAPER HOLES WITH A DRILL PRESS

desired, any style hole, either straight or taper, may be bored.

Every drill press of the radial-arm type has a floor plate. To this plate is securely clamped the plate *A*, which holds the dead center. This cutter is lined up with the drill-press spindle, and all clamped solidly. The job is then set up on parallel strips and bolted securely down. The sliding cutter is then shifted to, as nearly as possible, the correct position for the taper to be bored, and the bar put between centers.

The bar may be driven as shown in the sketch, or in any other convenient way.

By the use of two or three feed pins, a greater feed may be obtained, but in boring taper holes it is not advisable, as only one tool may be used in the cutter head *B*. For straight holes two or more tools may be used. This forms a splendid outfit for a small shop, as it makes your drill press a veritable vertical boring mill.

Another method of obtaining the offset at the upper end of bar, is shown at Fig. 2. Here the centers are laid off spirally, at quarters, but this is not so good, as a small variation is hard to get with this arrangement, and it also necessitates four grooves to hold tools, as the tool must be clamped in the groove on the side opposite to the offset center in use.

Vallejo, Cal. FRANK S. BUNKER.

Flat Pin Doweling a Smooth Box

During the erection of a new and somewhat experimental machine, it was found necessary to make use of a plain flat box to contain a journal bearing which was fitted with a gear at either end of the box and therefore subjected to all the strains which could exist in such a piece of mechanism. The flat box was five inches long and was made as shown in Fig. 1, without the usual lip to prevent lateral motion between box and cap. In fact, nothing but the bolts and the bearing itself was available to prevent the cap from moving around at will.

It was decided that to put in pin dowels would be only a waste of time, as nothing larger than ⅛-inch could be drilled in, owing to the scanty dimensions of the box in question. It was feared that the dowel arrangement would prove merely a wire-cutting device to shear off the dowels when strain came upon them; therefore the dowel method was abandoned and the flat-pin arrangement used instead as shown in Fig. 1, where *A A* represent two of the dowels which are mere bits of round wire, but they are called *flat-pin* for the reason that they lie parallel with the joint instead of at right angles, as is the case with pins.

One-half the hole is drilled in the box, the remainder in the cap; and to prevent the pins from falling out when the cap is off, the following method of fastening them in place was used, a hole *B* being drilled at right angles to the hole *D*, Fig. 2, which hole is the same as shown at *A A*, Fig. 1.

Hole *B* is drilled ½ to ¾ inch deep, and another shallow hole is drilled at *C*, or the corner is cut off with a file or a round-nosed chisel so that the pin, when bent at right angles, will not be interfered with by the sharp corner between the two holes. The hole *B* should be a few thousandths smaller than hole *D*, in order that the wire which lies snugly in the latter hole will fit tightly when driven into hole *B*.

The driven-in wire is shown by dotted lines in the hole at *E*, and when in this position the projecting part of the wire is bent down by means of a hammer or a mallet and forced into the horizontal hole as shown at *E*, Fig. 2. This is all there is to the matter. The pin now presents a shearing surface of many times what it could be were the pin to be driven crosswise of the plane of shear. To make the matter sure, four pins were thus fitted, one in each corner of the bearing. A slight improvement could be made in this ar-

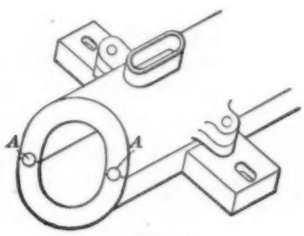


FIG. 1

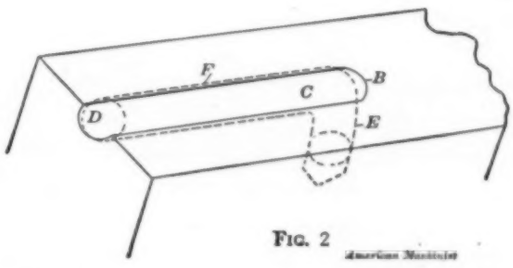


FIG. 2

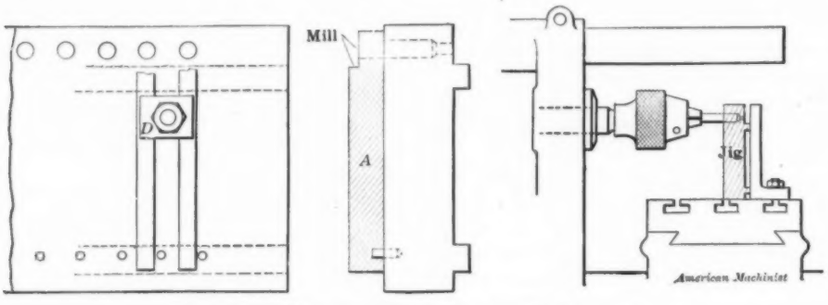
FLAT PIN DOWELS

rangement by bending the other end of the wire at right angles, making a sort of staple of the wire. Another hole would have to be drilled for each piece of wire, but as both ends of each wire would then be solidly held and there could be no possibility of its ever coming out, no matter how roughly the box might be handled during repairs or transportation.

South Bend, Ind. J. F. HOBART.

Drilling Holes on the Milling Machine

To make a milling jig for milling recess in the piece *A*, it was necessary that there be no variation in the alinement in the locating studs and pins for holding pieces in the jig, as it was intended to mill 16 at a time on the one jig.



DRILLING HOLES ON THE MILLING MACHINE

The block for the jig was machined all over and then set up on a Kempsmith milling machine and squared up true to the table, as shown in cut.

In this way the first hole was drilled by being laid out on the surface of the jig and drilled by the drill chuck and drill, as shown. The other holes were then micrometered by using the micrometer dial on the feed screw and drilled from this hole.

The small holes for dowels were treated in like manner and it was found that the holes varied but 0.0005 inch.

The pieces are held on the jig by the clamp *D* when milling and centered and gripped by the stud which fits into hole already drilled in the end of piece. They are then secured to prevent side play by dowels on the side.

Ashburnham, Mass. K. P. A.

Determining the Cutter for Parallel Depth Bevel Gears

On page 62, Volume 32, Part 2, you had an article on "Parallel Depth Bevel Gears."

I have been a good deal interested in this article in that I have made a few pairs of gears after this method, and will probably follow it continually, but in the article as it appears, there seems to be a very great difference in two methods of arriving at the number of the cutter to be used in cutting these gears. In the part of the article where method of laying out is given, the method of determining the cutter to be used is the same as is used for the old style of bevel-gear cutting, while in the sketch which belongs with the part of the article which deals with the cutting of these gears, the method of determining the number of the cutter does not, as it seems to me, have any rational bearing on the case. It would seem to me that the proper method of determining the cutter for this work would be to use the same method as the old style of bevel-gear cutting, excepting that instead of using the outside-pitch diameter, the inside-pitch diameter should be used. This, then, agrees with the old method of arriving at the tooth shape, in that the number of the cutter gives the required tooth shape for the end of the tooth where the cutter is making the shape which would correspond with a spur-gear tooth. I have made two or three pairs of gears using the cutter arrived at in this way and find that they run without difficulty.

I will appreciate very much an opinion as to the proper method of determining the cutter number, through the columns of the AMERICAN MACHINIST.

BENJAMIN D. CHAMBERLIN.

Corning, N. Y.

Rocker Arm Bolt Puller

The accompanying illustration shows the method used by the Chicago & Northwestern railway in their shops at Clinton, Iowa, for removing valve-rod pins that have a tapered drive fit in the top of the rocker arm.

The pin is always damaged by driving it out with a bar from the opposite side of the engine, but using the yoke and key and hydraulic jack, as shown, this pin can be removed quickly and without any damage to it.

The yoke is held in place by a stud bolt through the cored hole in the rocker arm.

This line cut gives details and will be plainly understood.

Clinton, Iowa. W. J. SHADLE.

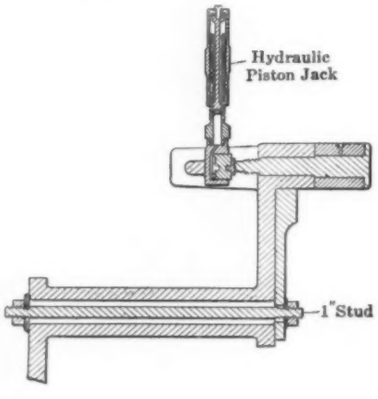
Buying Machine Tools

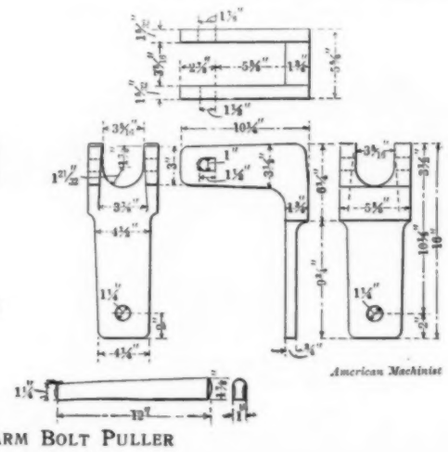
The different views on this subject have been of absorbing interest to me, as I found myself face to face with this problem some time ago, and in such a way that it was to be very greatly desired that no mistakes be made.

The total amount of money to be invested was not large comparatively, yet for the place it was a considerable amount. A new shop was to be equipped, and as I had charge of the shop, was directed by the owners to select what machinery was needed. It was easy enough to name such machines as a class, but when it came to maker, size, type, etc., that was different.

There was one thing in this direction that I at first was inclined to find fault with. I could not, on my own account, ask for quotations or catalogs. I do not know but that it is a good plan in some cases as regards quotations, provided the best machine is desired and the chooser is a good mechanic, for it does not exert any undue influence because of some predetermined amount to be paid for machines.

Catalogs were sent for by owners upon request, and a systematic study of designs was commenced, upon the parallel-column style, and every make of tool was





ROCKER ARM BOLT PULLER

gone over in this way and again to determine its fitness for our purposes. Personally, it would been my preference to have visited the shops where the machines were made, but that was out of the question, as I was working every day, and the result might have been less satisfactory than the one followed.

The question of design was the one given most attention, as the workmanship was assumed to be equal in all cases, as no machines were considered except those of standard make. It was in this case that my habit of studying the advertising section of the AMERICAN MACHINIST stood me in good stead. Of course, we had calls from the dealer and from company's representatives as well, and when they came I would go over their machines with them and the owners would go over prices.

Some representatives were mechanics and could really tell you something about their machines, and others were not—could only recite. It so happened that a grinder salesman made a call coincident with the appearance of a display ad in the AMERCAN MACHINIST of a mirrored metallic surface. It further happened that such a surface was very greatly desired by the customer only a short time before and not to be had by means then at hand. It produced such an impression upon the owner, who had a preference for another make, that he was not hard to bring to my way of thinking, as I had previously decided to recommend this make because of its fitness for our uses. In only one case did a representative take an order away with him, and his machines had practically been decided upon before his arrival. The owner, as I mentioned before, would get the prices and in a few days would take up the question with me and send in his order.

Every machine bought was upon my recommendation and selection and is proving admirably adapted for the work in hand, which is small and of a very varied character. The slogan of "Say you saw it in the AMERICAN MACHINIST" was very effective, of great help to one who had not benefited except by the satisfaction of seeing and using the things that heretofore had been in the mind's eye only. In two or three instances, in the case of machines that were new or I had not seen, the above expression was, in effect, used to support my contentions.

It is my contention that "A live mechanic who studies the advertising columns and uses that knowledge in conjunction with the work he does in the shop is as well fitted, if not better, than anyone else to select your shop tools." It is not always the machine with the greatest belt pull that is your best money maker.

Urbana, Ill. E. T. STRONG.

A Hinged Taper Die

The accompanying sketch, Fig. 1, shows a piece of work for which a certain brass shop in which I was at one time employed took a fair-sized contract without having the proper tools. The piece is a gas fitting and the order called for several hundred gross.

After several discouraging attempts to do the taper threading cheaply, I devised the rough tool shown in Fig. 2, this being

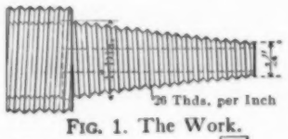


FIG. 1. The Work.

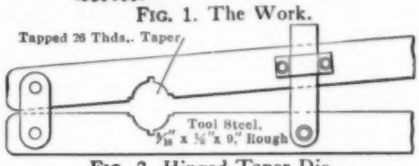


FIG. 2. Hinged Taper Die.

a hinged taper die. The work was done by this tool with remarkable speed, producing a very satisfactory thread.

Leicester, England. A. ELSMORE.

Hand Seating Tool

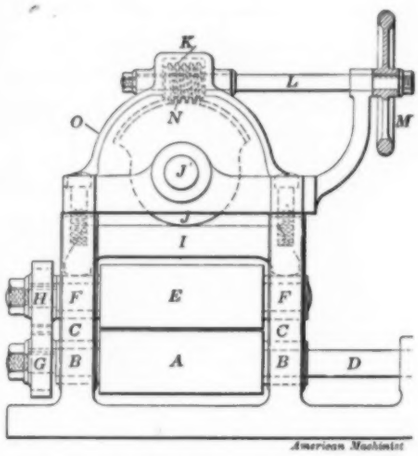
The accompanying drawing shows a homemade tool which is used to face the flat seats for oil and sight feed connections on the bulls-eye lubricators. To use this tool, insert the threaded end of iron plug which fits the threads in lubricator. The cutting tool is then inserted over the stem on the plug, and is held against the seat by hexagon nut. One or two turns of the cutting tool with a wrench will make the seat as good as new.

CHARLES MARKEL,
Shop foreman, C. & N. W. Ry.
Clinton, Iowa.

Feed Roll Adjusting Mechanism

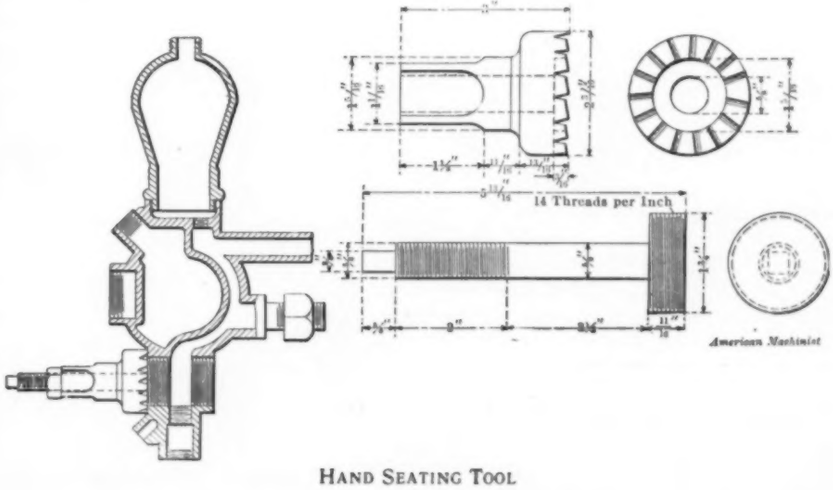
This mechanism is used with power presses, for feeding sheet stock to the dies, and is especially adapted to subpress work. Its main purpose is to provide a powerful, self-locking roll adjustment in which the rolls adjust themselves to inequalities in the thickness of the stock.

The lower roll *A* is journaled in suitable bearings *B*, located in the housings *C*, and is driven by a friction feed on shaft *D*. The upper, or driven roll *E* has bearings *F*, also supported in the housings *C*. Pinions *G* and *H* cause the rotation of the upper roll *E*. Above the roll



SELF-LOCKING ROLL ADJUSTING DEVICE

E is a bar *I*, whose ends rest upon the bearings *F*, of the upper roll; and above the middle of the bar *I* is placed the eccentric *J*, on a stud *J'*. The eccentric *J* has worm teeth *N* on a portion of its periphery, engaging with a worm *K*, which is operated by means of a shaft *L* and a handwheel *M*. A casing *O*, secured by screws to the top of the housings, covers the eccentric and the worm, and also con-



HAND SEATING TOOL

tains bearings for the stud and the worm shaft.

The worm gearing allows great pressure to be brought to bear upon the bar *I*, by means of the eccentric *J*, which has a very short throw, thus giving great purchase. The eccentric is self-locking in any position, by reason of the worm gearing.

If the stock to be fed is a little thicker on one side than on the other, the roll *E* simply rides higher on that side, bearing against the eccentric as about a pivot; or, if there is a lump or dent in the stock, the action is the same.

Springs, or rubber disks for cushioning, could be used in connection with the bearings of the roll, but in practice these were not found to be essential.

Brooklyn, N. Y. C. D. K.

A Universal Master Jig

Considerable time may be saved, where much accurate drilling is required, by the device accompanying this description, more especially in the constructing of jigs, dies, etc.

It is made, for the most part, of machinery steel and left soft, thereby avoiding the distortion sometimes met with in case-hardening. The drill bushings should be of suitable sizes, being made and kept according as the different jobs require them.

A straight-edge and protractor may be used in connection with the device, to obtain holes in a straight line; or at an angle to the working base.

To get satisfactory results, proceed as follows: Lay out, approximately, the first hole; drill and ream to the required size; after inserting the proper bushings in the master, push a plug into the work through the fixed bushing, and another into the movable bushing which is then clamped the required distance from the hole drilled, using any convenient method of measurement. Then drill and ream.

A little study of the sketch will make obvious its advantages as a quick and accurate device.

Hartford, Conn. H. H. ELLIS.

Penetration of Cast Iron by Lubricating Graphite

At a chance meeting of a number of engineers that occurred recently, the conversation drifted from one thing to another, and finally to the subject of lubrication.

As I had been employed as engineer in the refinery of one of the large oil companies and also in a line of business in which graphite enters very largely into the product, it was natural that my views, especially as to the use of graphite and its effects on metal should be asked. Those present were surprised when I told them that cast iron, when long subjected to the action of graphite, or crude oil, absorbs or becomes impregnated with the carbon therein contained, to such an extent that it assumes a graphitic state.

To illustrate: Several years ago I had occasion to renew a piece of apparatus which was used in purifying graphite. The construction of this apparatus was such that the graphite mixed with water passed through cast-iron tubes and over cast-iron flanges, and the same had been in use for a period of, perhaps, 20 years. Some of these tubes which also acted as trunions, had become worn and were replaced with new ones.

In breaking up these tubes and flanges it was found that the cast iron to a depth of from 3/16 to ¼ inch had become thoroughly impregnated with graphite, so that it could be cut like the old-fashioned stove polish; the life of the cast iron seemed entirely gone. It had lost nothing in thickness, but the surfaces exposed to the action of the graphite and water had virtually turned to graphite as above mentioned.

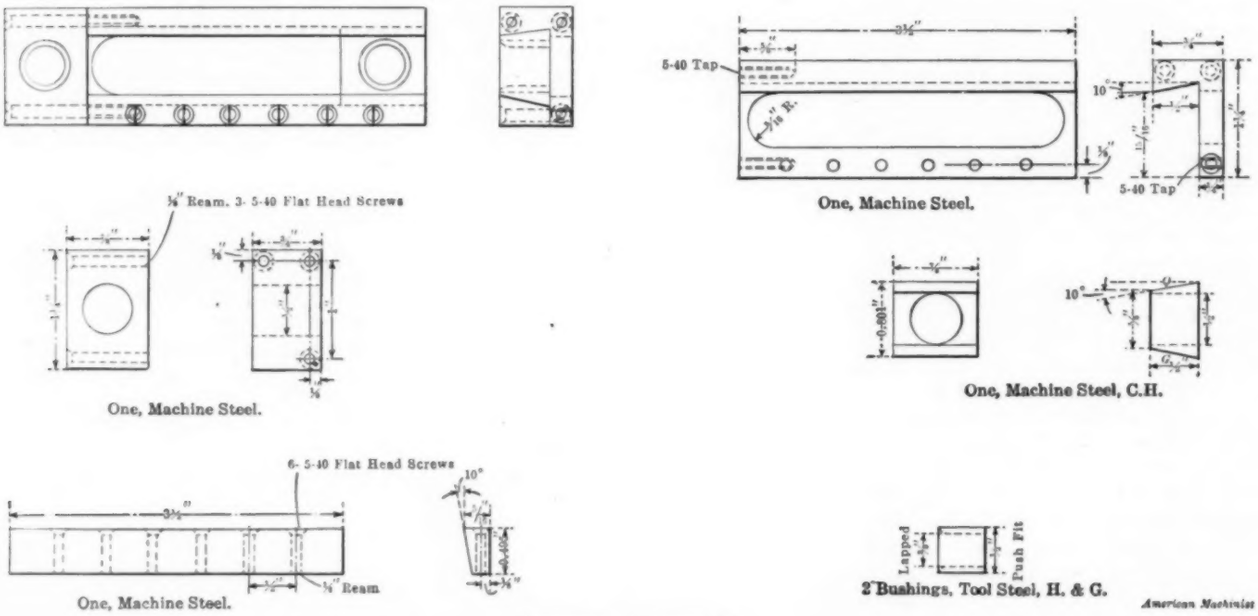
In other apparatus, in which similar mixtures of graphite and water were treated, but in which wrought iron or soft steel was brought into contact with the mixture, the action was very different.

In the apparatus in which steel or wrought iron was permitted to come into contact with the graphite and water, it was found that the surfaces were very badly corroded or eaten into, in some cases shafts 2 inches in diameter were more than half gone. So far as I was able to learn, these shafts had been exposed to the action of graphite and water for periods of from five to ten years. Still graphite continues to be successfully used as a lubricant.

More astonishment was expressed, however, when I told them that the action of crude oil and petroleum on cast iron was very much like that of graphite.

While engaged in the oil business, I had occasion to renew some cast-iron pipes in the refinery yard, and was very much surprised to find that the inner surfaces of these pipes, through which crude oil had passed for a number of years, showed practically the same conditions as did the cast-iron tubes and flanges used in conjunction with the graphite apparatus. The nature or life of the cast iron appeared to be gone, or in other words, it had assumed a graphitic state.

Newark, N. J. A. W. JACOBI.



UNIVERSAL MASTER JIG

For Handy Pocketbooks and Desk Books

The appearance of the new edition of Kent's "Engineers' Pocket Book" is an event to be regarded with great satisfaction from many points of view. The fact that the original plates have been worn out in the printing of so many copies assures us that the author has received substantial remuneration for his exhaustive and persevering work of collecting, sifting and arranging in readily usable form data of practical value to the entire engineering profession. His work is not like that of the novelist which now rarely survives its single season, but is of enduring value and is sure of a constant demand.

This pocketbook, which, even from the beginning, was so valuable and so constantly serviceable to the working engineer, is now greatly enlarged and improved and is fuller than ever of detailed information of rules and formulas, every item of which will come in at some time to fit a practical want of some busy man and save him valuable time and often prevent wasteful research. Perhaps another decade in the development of our industrial processes and in the piling up of experimental acquisitions may render necessary another enlargement of bulk equal to the present addition, but, as it is, the pocketbook is no longer a book for the pocket, even if it ever was. It is indeed a monument of the constant pocketbook accumulation of data, but as a whole it belongs to the desk and not to the pocket.

It is too bulky even for convenient use at the desk or upon the table, and has the habit of not lying quietly and comfortably open at any page required at any given time. If the pocketbook were, say, one-quarter the thickness of the present standard, this objection would be minimized or would indeed disappear entirely. Why not, then, make the pocketbook in four volumes instead of in one, and have the binder use his art to make the pages lie as required? This is not a difficult thing to secure.

There is a still better reason for urging the dividing of the pocketbook. If we look at such a book on the drawing board of a designing engineer or on the desk of the busy writer of specifications, where it has been a handy tool in hourly use for a year or more, its condition will show that only certain portions of it have been in frequent use and show dirt and dilapidation in consequence, while most of it may be said to be as good as new. It should be possible to renew the part as required instead of the whole when not required. Possibly the pocketbook will some day consist entirely of cards, each independently renewable, but that day is not yet.

I feel that in this connection I may be permitted another suggestion. In the pocketbook before us there is absolutely not the slighest trace of perfunctory filling or padding, but everywhere evidences of industrious sifting and condensation for economizing space and the suggestion of dividing the book up into. say, not less than four separate parts is entirely for convenience in use and sometimes for replacement with the certainty that the entire work would be bought at least once in any case. Indeed, this might be insisted upon by the publishers.

There are, however, other books than pocketbooks which suggest subdivision. When books upon strictly technical topics are prepared for the information and the use of professional men, these books quite generally presenting a mass of honest and excellent work, and when at the end, apparently to make the book of salable size, there are appended collections of tables such as we look for in all the pocketbooks, tables of logarithms, of sines and tangents, of areas of circles, of squares, cubes and roots, etc. Would it not be well if the filling were in one book and the padding in another? The division would be perfectly practicable in such a case, but in another book before us, containing some excellent material, there is scattered all through it matter to the extent of, say, 30 to 40 per cent. reproduced, cuts and description from manufacturers' catalogs; what can we do to separate the wheat from the chaff in such a case?

New York. TECUMSEH SWIFT.

Hexagonal Shanks for Twist Drills, etc.

In my thirty years' experience in machine shops, with the aid of nearly a continuous subscription to the AMERICAN MACHINIST during that period of time, I have never seen a satisfactory chucking method for driving twist drills, reamers, boring bars and other tools in a drill press, until, in utter despair, I hatched one myself. It was the simple plan of making a plain hexagon out of a round straight shank on drills.

There are many methods in use, but all of them have such great faults that not one of the whole set has the slightest chance of ever being universally adopted. The taper shank breaks too many tangs to be practical, and besides, it requires too much changing of sockets. Also the cost of making special tools for drill presses runs too high if a taper shank is required.

Some patent drill chucks have merits, but all of them have faults. The main one is the small range of capacity in sizes of drills, necessitating the changing of chucks for every quarter inch in size of drill. This will never do. The ultimate drill chuck which will become universal soon after its introduction will have capacity for the largest drill the press will drive, down to nothing. It will be put on the press and left there until the press is worn out.

The ordinary two-jawed drill chuck made by a number of factories, and everywhere on the market answers the above requirements except that it wears out very rapidly, also wears out our patience by not driving the drill. Also wears ugly grooves in the shank of the drill, it offers inducement to apprentices to use a gas pipe on the socket wrench whereby he twists off the wrench or breaks the chuck screw. It has capacity for all these evils, and is still the best all around driving method on the market for drills. Such being the case it behooves us to either devise a better means entirely for the purpose or to do something radical to perfect what we have, because the matter is of such enormous importance—millions of drill presses running without an adequate means of driving the drill.

In the works of the Commercial Engine Company, of Los Angeles, drills, reamers and special tools are milled to a straight hexagon shank, the angles then exactly fit any ordinary chuck jaw and forever afterward nothing more is heard of drills slipping nor of chuck and wrench breaking. It is, therefore, with a certain degree of impatience that I read an answer from a twist-drill maker on the subject, saying he did not consider the hexagon-shank drill idea feasible because of the expense of producing the hexagon. Who would not gladly pay 50 per cent. more for a drill which would really turn without fail when the press spindle turns, and would enable a common drill chuck to last fifteen years? Why do you find most drill presses running with the finest feed. Because with a taper shank the operator fears a heavier feed would break the tang off the drill and with a straight-shank chuck he fears the drill will stop and the chuck turn around it. Our drilling could be done with fewer drill presses if drills were driven more successfully. With the cost and delay of broken and worn out chucks saved, we could well afford to pay more for drills, if this hexagon shank will add to their cost, because such shanks would make driving so easy that chucks would not wear out. And it is my opinion that the factory which first gets on the market with hexagon-shank drills will gain an astonishing advantage in prestige on the market, and will confer an immeasurable benefit on that long-suffering portion of the public working in iron.

S. B. WELCOME.
Pres. Commercial Engine Co.
Los Angeles, Cal.

The State of Maine is the center of the spool industry, turning out 800,000,000 a year. White, canoe or paper birch, (different names for the same tree) is the wood most used because it shrinks and warps very little.

Discussion of Previous Question

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers.

Cause of Skew Teeth in Hobbing

Under the above title, at page 421, is given an explanation for the ground of complaint against one-sided gear teeth cut with worm-shaped spur-gear cutters. It should, however, be unknown to few factories in which hobbing machines are used that the hob, as well as the form cutter, must be adjusted accurately in the central plane of the wheel blank, and yet in shops which proceed carefully along this line the same complaint is to be heard.

In my opinion the cause is to be sought in the cutter itself; yet not, as has formerly been contended, through hardening distortion of the cutter teeth. In order to be perfectly clear on this point we must consider the methods of manufacture and maintenance of the cutter.

The cutter is backed off by setting the cutting tool at right angles to the direction of motion, so that its cutting surface lies in the direction of the cut; or, which amounts to the same thing, in the direction of the tooth face. In this direction later, during the milling, the plane of the gear lies, which is brought about by setting the gear axis around to the pitch angle of the worm thread of the cutter obliquely toward the latter's axis. After the cutter teeth have become blunt and are reground, its diameter is lessened. With this decrease of the diameter is connected a change (increase) of the pitch angle, since the pitch a remains the same, and the pitch angle α is determined by the formula

$$Tan.\ \alpha = \frac{a}{D \cdot \pi}.$$

That is, when the diameter D is diminished $tan.\ \alpha$, and therefore α, itself, is increased.

In grinding the cutter, the same pitch of the grinding helix is always employed. Theoretically it is desirable that the grinding helix (coincident with the direction of cut) shall run at right angles to the worm thread. In the practical use of the worm-shaped cutter, however, this is not the case; the grinding helix, and therefore the face of the tooth also, lies obliquely toward the worm thread. Therefore an oblique outline of the cutter tooth is ground.

What has been produced by way of a cutting outline for the cutter tooth, may be seen in the accompanying figure. On the right side of the drawing is shown a horizontal plan of the cutter face, and this is then swung upward. In both it is rendered evident how the theoretical cutting edge has run astray. Through the oblique position of the grinding helix there takes place at the top of the tooth a decrease of diameter, because the back of the teeth, by reason of its relief, falls off toward the rear. Correspondingly, there takes place at the bottom an increase of diameter. The outline is distorted in accordance with these variations.

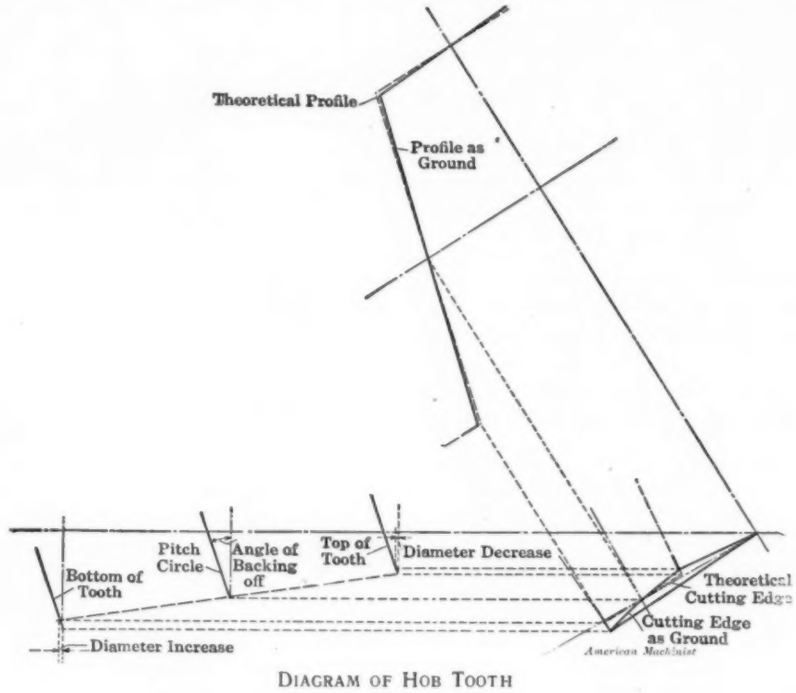


DIAGRAM OF HOB TOOTH

It is further to be remarked that this oblique form of the outline undergoes an additional distortion. As already remarked, the axis of the wheel is set around the pitch angle of the cutter thread obliquely to the axis of the latter. It has been pointed out, on the other hand, that this pitch angle grows with the diminution of the cutter's diameter. Of this change in angle, account is taken in the use of three different oblique angular positions: The first when the cutter is new, the second when it is about half ground away, and the third when it is nearly all ground away. For any intermediate diameter the obliquity is false. It is not, therefore, the outline ground on the cutter that comes into effect, but its projection on the plane of the wheel. Since, in consequence of what has been stated, it casts an oblique projection of the tooth face upon the plane, there results a deviation of profile similar to that in oblique grinding, and both distortions may be cumulative.

Aachen, Germany. C. BARTH.

Machine Framing

In a recent number of the AMERICAN MACHINIST mention was made of a machine in which the post was of square section reinforced by internal ribs. The question with me is how metal can be put in ribs so as to be as servicable as the same metal would be if added to the walls of the box? I will let the fellow who does it, or the engineer who designed the Quebec bridge, turn up the evidence; but so long as I know one two-inch plank is twice as rigid against bending and twisting as two one-inch boards, and so long as when I have to pry up something I get as near the end of the lever as I can, I will put the extra cast iron in the walls of the square box.

These two statements may not seem like argument; but that, in my opinion, is just what it comes to in the end.

Syracuse, N. Y. JOHN E. SWEET.

Roller Bearings in the Line Shaft

On page 544 there was set forth the considerable advantage of the anti-friction bearing as applied to line shaft, over the better known, and still, perhaps, more largely used, babbitted bearing. It is, of course, a fact that total friction between any two surfaces is proportional to the area of contact, and it must therefore be admitted that the ball bearing, having only point contact, must necessarily permit of obtaining the minimum of friction possible for any bearing. This, then, would be the ideal bearing, if a theoretical coefficient of friction were the only thing to be considered, and expense, convenience, etc., could be disregarded.

In the majority of plants where improvement or refinement is contemplated, it usually is found that there are already many babbitted bearings in operation with more or less satisfactory results. These are installed under conditions favorable to a split bearing, and under circumstances where it would be impossible to make replacement with a bearing that necessarily has to be put on over the end of the shaft and moved lengthwise the entire distance up to its proper position. Even though it were possible to lay out an entirely new proposition, so as to make available a bearing of this kind, the annoyance of having to strip a long shaft of all its pulleys, to get to one bearing on the opposite end, which may be giving momentary trouble, can readily be appreciated and in fact this, together with the first cost of a bearing of this type, should undoubtedly be given most careful consideration by anyone contemplating a layout of such character.

A roller bearing, or bearing which is next in point of theoretical efficiency, can be applied in split form; that is, the retainer for the rolls can be made in two halves. The sleeve, if there is one, can likewise be split and therefore the whole proposition is, according to the nature of the particular bearing under consideration, applicable to forms of layout now taking a plain bearing. In considering a roller bearing itself, there are two classes of product which should be compared by the prospective user, before his decision, one way or the other, is made. The first of these may be described briefly as follows: It consists of the usual box with hard lining, providing an outer race for the rollers to run in; a set of solid, hardened and ground rollers, with retainer to keep them in alinement; a sleeve to be placed on the shaft and to form an inner race for the rolls. The second type consists of the box and lining just mentioned, and a set of flexible, helical rolls, with cage or retainer; which rolls are intended to run directly on the cold-rolled shaft.

In considering the advantages of either one of these types over the other, it can be borne in mind that the former has the greater number of parts and is, therefore, necessarily more expensive as regards initial cost. In addition, there are several points of operation which should not be lost sight of; among which may be mentioned the matters of lubrication, and friction due to flexing shaft. In the second type of bearing, with helical rolls (which rolls are hollow), two rolls placed side by side have their helixes running in opposite directions. Each roll, therefore, is in itself a reservoir which will retain oil and, by means of its helix and the arrangement of consecutive, opposite windings, will transmit this oil to all parts of the bearing readily and continually.

Line shafting is generally subject to more or less bending, due to varying loads and distances between supports. The flexible roll conforms at all times to the longitudinal curvature of the shaft, no matter how slight or how great it may be. The accompanying table gives comparative coefficients of friction for the three types of bearing here considered, under as nearly equal conditions as were at the time obtainable. These figures are an excerpt from complete data obtained by a very careful and extended test recently made at Pratt Institute, of Brooklyn. Conditions were made, by extreme refinement, as nearly equal for all three bearings as possible; at the same time, an endeavor was made to operate all bearings under what would be a fair commercial condition for the specified load, and the fact that the solid roller did not show up better is believed to be partly, at least, due to the increase of friction caused by the deflected shaft in this case having to run between non-flexing rollers. The results for other loads and speeds were equally favorable for the flexible roller.

Bearing.	R.P.M.	Load (lbs.–sq.in.)	Coefficient of Friction.
Babbitt	234	50	.0122
Solid Roller	200	50	.0115
Flexible Roller	240	50	.0041

TEST RESULTS OF ROLLER BEARINGS FOR LINE SHAFT.

It is to be noted, too, that by the use of this special type of roll it is possible to eliminate the sleeve, and to run the bearing directly on the shaft, without the resultant wear which always is attendant as a result of running, in a similar manner, a solid hardened and ground roller.

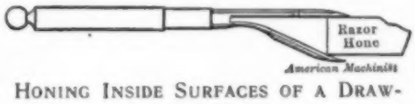
Newark, N. J. RALPH S. LANE,
Engineer, Hyatt Roller Bearing Company.

Sharpening a Drawing Pen

On page 266, Lucien E. Picolet shows a method of sharpening a drawing pen, but omits a very necessary, although many times overlooked point; the condition of the inside surfaces, which, if not of a high finish, no matter how well the points are shaped, will not allow the pen to work at its best. A very good way to put the inside edges of a pen in condition is to spring the pen over the edge of a razor hone. A narrow hone will enter almost any pen; one blade of the pen can be pressed flat on the stone and rapidly moved to and fro, while the other blade, sprung over the edge of the hone, helps to keep the first blade flat.

A pen that is well sharpened but not as smooth as can be made by honing, will, after honing, allow the ink to flow much easier and freer. A much finer line can be drawn with a pen that has its inside edges or surfaces honed, than one that has not been so perfectly finished.

The cause for this is not hard to see.



HONING INSIDE SURFACES OF A DRAWING PEN

Drawing pens, as furnished by the manufacturers, are finished crossways of the blades on the inside, and the lines left by the finishing process are very plain to the naked eye. These lines act like grooves to hold the ink from readily flowing down to the point of the pen, and to remedy this condition use a very fine razor hone (not an oil stone), and put a finish on the inside surfaces of the pen that will show no lines of direction of finish. It will be astonishing how much easier the ink will slide down to the point of the pen.

Pittsburg, Penn. A. H. DYER.

Calculations for Hobbing Gears

Referring to the article on "Calculations for Hobbing Gears," we notice that no time is allowed for the travel of the hob until the center of the hob reaches the edge of the gear. This varies in accordance with the diameter of the hob used and the formula as given does not take this into consideration. On a hob of moderate diameter this travel is about 1 inch, which would add some additional time to that which would be computed according to the formula given. Undoubtedly it was an oversight in not mentioning this in the article and we are simply calling attention to it for the reason that the actual cutting time would be more than the result of this computation given in this article.

Newark, N. J. GOULD & EBERHARDT.

Machine Tools of the Future

The editorial at page 601 reminded me of two things; one that the ups and downs of business, like the ups and downs of the stock market, have no effect in the long run on the man who owns his shop or his stock. It is only the man who buys his shop or his stocks on a margin who is affected. Borrowing money is gambling because there is no knowing what it will cost to pay it back.

I remember one old chap who used to tell me that he never paid over 5 per cent. for money and yet I knew of his borrowing money when it was easy to get, and paying off the loan when it was worth twice as much, supposing a day's work to be a unit of value. He really paid about 25 per cent. a year for 5 years. On the other hand with prices of labor, food, etc., steadily going up a man might pay 5 per cent. interest in money and yet really get it for less than nothing.

The other thought was this—that the tendency of the times in machinery, whether machine tools or engines, must inevitably be away from pure manufacturing toward engineering. The building of a hundred planers or millers of one size and one design is a factory or manufacturing proposition. The building of a hundred planers or millers each adapted to perform one operation on some pieces of machinery is an engineering proposition. We have been very proud here in America that we turned out the finest machinery in the world just as a ready-made clothing house turns out its product. It has been adapted to an average condition. Our shops are full of machinery that fits average conditions but which fits special peculiarities about as well as the ready-made suit fits a man of 6 feet 6 inches with a 32 chest measure.

I believe that we should hail the new order of things when it comes with the intent to maintain the national pride as ever, but not by attempting to let down here and take up there on our standard machinery to make a bluff at a fit. We need to take these cases which demand special machinery and build special machinery which is newly designed from the ground up.

The unfortunate thing is that our shops are full of men of limited elasticity, men who cannot do anything unless they have jigs and fixtures and operation sheets and work in large quantities. If this new order of things comes about these men will no longer be able to hold their own but will suffer the fate of the stage driver and the men who chipped and filed lathe beds.

The man who will come to the fore will be the type of the old New England machinist of whom Chordal loved to tell and who is to be found today only as the owner of shops all through the Middle States where the recent jig and operation-sheet automatics are employed. But this man will have to be a step in advance of the old Yankee with his multitudious tricks of trade, because he must run machinery and construct machinery which is infinitely more involved and complicated than the older men had to deal with. He will have to have a knowledge of mathematics which in its need of accuracy will put a college graduate to shame and he will need an ingenuity and inventive ability that will place his income alongside the best designers of today.

If I were a young man just starting out in the shop today I would take every chance that offered to become versatile and to get a grasp of mathematics, not as it is taught in high school, but as it is used in the shop and drafting room, and I would endeavor to add to my accomplishments a knowledge of drawing sufficient to enable me to make a drawing of anything that I could wish to make. Then I would resist the temptation to go into a drafting room but would stick to the shop, for that is where the big money will be if my prediction is true that we are approaching an era of engineering in the shops of the country rather than manufacturing.

Springfield, Mass. ENTROPY.

Why Machines Do Not Make Good

John R. Godfrey's talk on page 764 is true of many other things beside machine tools. A short time ago, the writer was in the employ of a corporation as machine-shop superintendent and the men with whom he was compelled to do business were employees of sports and others who could and could not afford to ride in automobiles. Having received strict orders to do only first-class work, regardless of cost, the writer engaged the best mechanics in their respective lines, and turned out the work in the best possible manner.

But the men who had the work done were accustomed to receive gratuities, and these were unknown in the institution referred to. The result was that the workmanship, materials, etc., were condemned from beginning to end, and you can readily see how a person maliciously inclined could destroy in a very few minutes what it would take days to make good. This was truly a very bad state of affairs, and one which forced many owners of automobiles to make a change in the class of men employed. Former coachmen received instructions in driving, and had strict orders to take the machines to the garage machine shop when they got out of order.

The owner of a high-class foreign car, which the maker had equipped with a low-tension ignition, ordered that a high-tension ignition be put on.

The high-tension ignition worked perfectly when it left the shop, but complaints came thick and fast. The tester was an expert in his line, and respected as such by all who knew him. The owner of the machine was next requested to take a ride with him, after the mechanism had been readjusted, and he pronounced the running of the car satisfactory in every respect. He next issued orders to his driver that to adjust anything on the motor end of the car meant his instant dismissal, and the trouble was at an end.

Another illustration as to how far this personal element enters into the successful working of a machine, is shown by the experience in other lines. The manager of one of the largest wagon and carriage concerns in this section of the country said a short time ago that if they did not do the nice thing by every coachman who drove one of their coaches, they would be forced out of business; in other words, they considered this gratuity was one of their legitimate selling expenses, and found that it was one which brought the best returns. As one of our former Presidents said, "It is a condition and not a theory which confronts us," and we must make the best of it.

Plainfield, N. J. X. Y. Z.

Hardening Twist Drills

In answer to Robert Dupont's article on page 694, if a piece of steel, or drill is heated to 2300 degrees Fahrenheit in order to harden it, and then raised to 400 degrees to temper it, the result would most certainly not be the same, as hardening at 1900 degrees, or 400 degrees less than 2300.

If the drill was hard enough at 1900 degrees, the result of heating to 2300 degrees would be to enlarge the grain crystals, and thus tend to injure the steel, and if the steel was injured or the grain crystals enlarged, it would have to be heated to the recalescent point to refine the grain, and certainly 400 degrees would not do that.

The manufacturer knowing the alloyed contents of the steel certainly should have known the relascent point.

Pittsburg, Penn. GEORGE WILFERT, JR.

An Adjustable Indicating Caliper

The adjustable indicating caliper illustrated and described by Peter I. Linnahan on page 722 is very ingenious, but I have had a similar one in my tool chest for about 10 years, copied from an original made 17 or 18 years ago in London by a Swiss mechanic of the name Ritter, and *patented by him*. It differs in details but the principle is the same.

"There's nothing new under the sun."

JOHN P. WHEELER.

West Orange, N. J.

Suggestions in Tool Designing

By E. E. Minard *

Extracts from a paper presented to the Technical Association of Chicago, Ill., that brings out some interesting points in connection with jig and fixture designing departmeuts.

*Tool designer, Western Electric Company, Chicago, Ill.

Tool designing began with the advent of interchangeable manufacturing. Its progress was slow, and usually found expression in free-hand sketches and verbal instructions by the foreman or superintendent. In watch factories and fire-arms shops the more complicated tools were laid out, and in some cases blueprints were made, but not until about ten or twelve years ago did tool designing become a prominent branch of engineering, and since that date its growth has been rapid and now practically all manufacturing concerns of any magnitude engaged in the production of interchangeable parts, employ tool designers.

It has been found to be much cheaper to produce a design on paper, than to make up parts that will not assemble, or faulty in some other manner which could have been foreseen on a drawing. But I do not wish to mislead anyone into thinking that tools made from designs which have been carefully worked out on the board never fall short of performing the operation for which they were made. For it is a fact much to be regretted that not all tool designers are practical men having shop experience, and some of those who have had this shop experience are not practical in the use of the knowledge gained.

It is not difficult to criticize an idea when it has been worked into a concrete form, but it has been my experience that toolmakers and machinists who were the most profuse in their criticisms of the designs of others, change their opinion when they are assigned to a board and instructed to design a jig or fixture for this or that piece. This is but the natural result of a change of viewpoint, and human nature works along practically the same lines whether it be a question between the management and employees, the heads of different departments, or the employees of different divisions of the same department, and the opinion of a man is pretty apt to be affected by his position in the organization and his own personal interests and ideas of design.

Standardizing Designs

Here is where the question of standard design enters and gathers the practical ideas together, unifying and developing them till they represent the best practice obtainable for the line of manufacture under consideration in any particular shop or, to a great extent, for all shops so engaged.

It is true that standardization can be carried too far and make designers mere machines, stifling initiative in design and personal interest in the work and defeating the very object which it is desired to attain. But standardization of units and parts which are used over and over again, relieves the designer and detail draftsman of the drudgery of routine work and allows him to use his energy in producing more effective work and greater output. This leads to an increase in salary, an attainment not to be despised in connection with present high cost of living.

Did you ever consider the enormous amount of wasted effort spent in producing something that is just a little different from something that has proved its value, just for the sake of making something that is different?

Watch your own movements for a day and see how close to a straight line you are moving in thought and action. I think you will find a great many curves that need to be straightened, and you are untrue to yourself and your employer if you do not strive to grow in knowledge and skill and fit yourself for a higher position.

In cases where the line of work is varied, and a number of designers and draftsmen are employed, it has been found advantageous to divide the work into classes; for instance, Punches and Dies, Jigs and Fixtures, Screw Machines and Lathe Tools, Special Machinery, etc., with a designer of special ability at the head of each division, reporting to the chief tool designer. This classification and the routine of the department will, of course, vary according to conditions which have to be met.

Some Duties of a Tool Designer

My own experience and observation of a number of years, leads me to believe that the importance of good tool designing to an organization, and its effect on the production of a factory, is neither understood nor appreciated by the majority of managers, and is tolerated only as a necessary evil or as something to adopt in order "to be in style," as it were. Inventors were formerly, and still are, to some extent looked upon with a sort of awe, but how about the men who sit or stand over the board for eight or nine hours each day and turn out from one to four tool designs a week—and many of them inventions of the highest type?

There is another phase of tool designing which I wish to call your attention to, and that is, that it requires tact and diplomacy to a high degree of perfection, especially in a large works. Tools must be designed and make for a large number of departments, and to secure information from a number of foremen and furnish tools that will fully satisfy them and hold their respect, is a difficult task indeed. If a foreman is prejudiced against a tool, the case is a delicate one and requires careful handling to get a square deal and have the tool tried out on its merits. Careful and thorough training and education, natural ability and self-control on the part of each one of us will enable us to win out, and every case won will make it easier to win the next one and eventually raise tool designing to the high standard that will command the respect of all manufacturers.

Dividing the work along the lines suggested brings out another point, that of specialization. When the country was new, men engaged in professional business or trade life were general in their attainments, all around men, if you please. But today is the day of specialists, and if you are not big enough to make a first-class, all-around man in your line, specialize in some branch and make a first-class specialist, strive to be the best in your line and you will find plenty of opportunity.

One of the difficulties experienced by manufacturers is to secure men who are capable of making good their claims of being thoroughly capable and experienced men.

Managing the Tool-designing Department

Primarily, it is the function of the tool designing department, if it is organized as a separate department, to furnish information to the shop in the form of orders, drawings and layouts, conduct special investigations of methods of manufacture and recommend such changes in equipment as seem desirable, keep a record of tool and pattern orders and drawings, file tracings, blueprints and correspondence, change old tools and patterns, and follow up orders to see that they are completed on or before a specified date.

In the case of tools for new apparatus, blueprints of the assembled apparatus or machine, also of each piece of detail, are furnished in the tool-designing department by the main drafting department, also a copy of the manufacturing authorization is furnished, which states the yearly requirement and the code number and authorizes the manufacture of the apparatus, or machine. It naturally fol-

lows that the larger the requirements the better the grade of tools to be made, and consequently, the design must be worked out accordingly.

A tool analysis is then made, giving a list of operations and classification of tools from which tool requisitions are written up and, together with blueprints, these are delivered to heads of divisions for them to have the necessary tool drawings made.

Drawings of simple tools are made in pencil on the dull side of tracing cloth and inked in, while more complicated ones are made in pencil on manila paper, and after being checked for design by head of division are turned over to a tracer for tracing. All drawings are checked for details and dimensions, and signed by all the parties interested in their production.

The next step is to turn in the tool requisition, blueprints and tool tracing to the clerical division, where the tool requisition is typewritten in the form of an order, blueprints made from tracings, orders typewritten for patterns, castings and forgings, and each distributed to the departments which are to do the work.

Promises of tool drawings are made out by each division head on special forms, so that each promise is shown graphically and allows a definite length of time. These promises are followed up by a card index at definite intervals which come up in file automatically.

Complete records of all tools are kept in card index form, including costs, etc.

All tool orders upon which promises of delivery are given are followed up in the tool-making department till finished, and turned over to the tool inspector, where they are given a rigid examination.

Making Changes

When it is found necessary to change a piece of apparatus or detail of a machine, it is good practice to send through a change order, approved by the engineering department and accompanied by changed blueprints, in which case the tool tracings are changed to conform to the new blueprints, orders typewritten and together with changed blueprints delivered to the tool-making department, clearing through a department, usually the tool-inspection department, so that the tool can be recalled from the shop and proper record made.

Great care should be taken to see that the proper notation is made on every tool drawing of each and every change made thereon after it is turned in for blueprints the first time, otherwise confusion and loss will result.

The Tool Inspector

There are two things that tool designers are not pleased to hear about, errors and rejections, and they go hand-in-hand. The position of the tool inspector is a very responsible one, requiring excellent judgment, and it is to be expected that sometimes rejections will not be accepted by the tool designer and toolmaker without at least an expression of opinion, which, to say the least, varies from that of the inspector.

It is often remarked that "variety is the spice of life," and it can be safely said that the life of a tool designer during a busy season is spicy enough to suit the most exacting taste.

There are altogether too many would-be tool designers and a big demand for the real, live, uptodate kind, and I do not know of any branch of engineering and designing which requires a broader knowledge and experience. It does not pay you to be anything but the best, and my advice is to dig for it and not be satisfied when you have just broken through the surface.

A Novel Piston Inlet Air Compressor

Special Correspondence

An English air compressor having central inlet ports admitting air between the faces of a double piston.

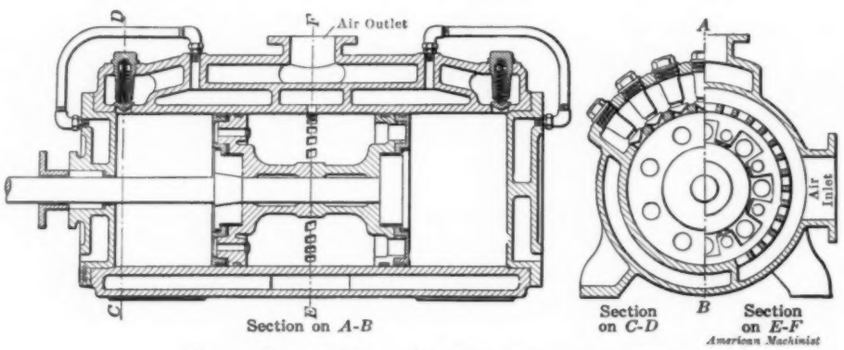
Annular valves in piston faces, operated by motion of piston.

Advantages claimed are free and direct passages for complete filling of air cylinder.

The accompanying line cut shows, so clearly as to require little explanation, the essential features of the air cylinder of a compressor built by John Wood & Sons, Ltd., Wigan, England. As will be seen, it embodies quite completely the piston inlet principle, but with such a difference as to make it almost unrecognizable.

The air is brought by an outside passage to the middle of an elongated air cylinder, which, it is claimed, is always cool at this central portion, and enters the cylinder by radiating ports all around it. The two piston faces are widely separated, or they, in fact, comprise two pistons fixed upon the same rod. There is an annular valve in the face of each piston covering air passages through it and it is claimed that these passages are of sufficient area to require for the valve only a slight lift, or movement. This valve is quite heavy and carries a packing ring of its own which fits the periphery of the cylinder, and by its friction opens or closes the valve with each reversal of the stroke.

A peculiarity to be noticed is that near the end of each stroke, the piston entirely covers the intake passages and momentarily must stop the inflow. It would seem that this might be avoided by a little additional lengthening of the cylinder, with a corresponding elongation of the openings around the walls. It appears, however, that the edge of the piston, or of its valve actually travels past the line of the air intake openings, and for the moment the cylinder interior is in direct communication with the surrounding air passage. This is claimed to assist in filling the cylinder. When the return, or compressing stroke for that end of the cylinder begins, the openings are closed again by the advancing piston. The arrangement also permits complete waterjacketing of both cylinder and cylinder heads.



Novel Piston Inlet Air-compressor Cylinder

The new buildings of the Purdue University, which are to accommodate the department of practical mechanics and provide facilities for instruction in mechanical drawing, descriptive geometry, and shop work, were formally opened on November 10. The plan and purpose of these new buildings have already been described in these columns.

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American Machinist

Editorial

A Few Facts

We recently pointed out in these columns that a study of distribution is necessary in order that we may have our just portion of the foreign trade of the world. We emphasized that the cultivation of a foreign market must be consistent and constant, not spasmodic—undertaken with the idea that the foreign market will send a continual stream of orders into the manufacturing plant instead of a flood of orders when times are bad at home.

In regard to the possibilities of some foreign markets, and showing the part that we play in their imports, we quote a few totals from the imports of metal-working machinery into Austria Hungary. These figures are taken from custom reports in which the machines are classified according to weight, there being six classifications. The total figures are expressed in tons of 22,000 pounds, roughly English tons. During the period, January 1, 1909, to December 31, 1909, the United States shipped into Austria Hungary, metal-working machinery to the extent of 551 tons; in the same period England sent in machinery to the extent of 185 tons, while Germany's exports were 8294 tons. Or expressed in easily remembered factors, we sent into Austria Hungary, during the period under consideration three times as much machinery as England, and Germany sent in 15 times as much machinery as we did.

Turning now to the period of January 1, 1910, to May 31, 1910, a period of five months, the United States shipped in metal-working machinery to the extent of 235 tons, England 298 tons and Germany 2988 tons. Or expressed in more easily remembered figures, England shipped in 1¼ times as much and Germany 12½ times as much as we did. It is beside the point to duscuss the surrounding conditions; it is enough to show that in this particular market, one of the rapidly developing markets for metal-working machinery in the world, we are pretty nearly at the bottom of the row. If we are to keep ourselves from getting into a condition of splendid isolation in regard to foreign trade, it is essential that in many quarters our method of soliciting be changed. Instead of its being a rainy-day job, it is a job for every working day of the business year.

Charts and Formulas

Much has been said of late regarding the superiority of charts to formulas for the purposes of the designer, but we doubt if a more striking illustration of this superiority was ever presented than that found in the chart for the design of hoisting blocks, which appears on another page of this issue.

At the upper right-hand corner of this page the formulas, of which the chart is a graphic representation, are given. The reader has but to glance at the formulas, and then follow through the explanation of the manner in which the chart is used in order to obtain the same results as those given by the formulas so as to have a realizing sense of the superiority of the latter. It is a case of "look on this picture, and then on that."

This chart, we may add, is the result of the expenditure of a good deal of gray matter on the part of its author. In cases like the present one, the design and construction of such charts is far from a simple matter, and every reader who makes use of the chart is under lasting obligations to its author.

Imports of German Metal Working Tools

Pertinent figures are before us showing the increase in quantity and percentage of the imports of metal-working tools from Germany, into the United States.

For the first six months of 1909 the exports of metal-working machinery from here to Germany aggregated approximately 1100 English tons in weight. For the corresponding first six months of 1910 the figure is 1500 English tons. This is an increase of about 40 per cent.

Turning now to the imports of German metal-working machines into the United States we find that for the first six months of 1909 the weight is 157 English tons. For the corresponding six months of 1910, this figure is 446 English tons, or an increase of nearly 190 per cent.

Also, our exports to Germany during the period under consideration increased only 40 per cent., while Germany's exports to us increased 190 per cent.

These figures are worth our careful consideration. They show the vigor with which Germany is reaching out for the

world's markets and the success that is attending her efforts.

The lesson for us is this: We too must reach out and grasp our share of the trade in the foreign markets of the world. We must so shape our business policies that a properly proportioned amount of effort will constantly be used in developing foreign trade, and a spirit of justness and fairness must prevail in apportioning products to fill both domestic and foreign orders. And above all, the foreign market must be looked upon as one that will take a steady stream of product, year by year and month by month, provided it is properly canvassed, and it must not be considered as merely a dumping ground for surplus product, especially in times of American depression.

The Aviation Meet

The crowds have come and gone; the final records have been compiled and published; presumably the aviators have received their money and the International Aviation Meet of 1910 is an incident of the past. To many persons and from many viewpoints, the meet was probably a disappointment. The relative merits of the biplane and monoplane seem no nearer determined today than they were a month ago. One of the striking events, the altitude contest, was won by a biplane; another, the speed contest, by a monoplane. At first sight this might seem to differentiate the uses of the two machines, but as several promising machines of both types were not really tried out, the matter is still in the air.

Yet one fact seems to have been brought home forcibly to all of us. That is the enormous horsepower that is required to get results in the air; the kind of results that are now being worked for. At Belmont Park we looked in vain for the low-speed, low-powered machine; a machine that might point the way toward a real use of the aëroplane in commercial transit. Such a machine was not shown, nor was there a suggestion of a type indicating promise for the future. Thus we were forced to turn away from the meet with a feeling of disappointment; disappointment because the aviators and inventors of the world, spectacular though their feats are, and daring their conceptions, have failed to show us real progress in the thermodynamic problem of aërial navigation as applied to commercial transit.

New Publications

Workingmens' Insurance in Europe. By Lee K. Frankel, Ph. D., and Miles M. Dawson. Four hundred and eighty pages, 6x9 inches; 145 tables. Published by the Charities Publication Committee, 105 East Twenty-second street, New York. Price, $2.50 net, postage 20 cents.

The fact that official commissions have been appointed in eight different States to study workingmens' insurance with a view of recommending plans for its adoption, makes such a book especially welcome at this time. In addition to this the various associations of employers are also studying the problem so that the subject can be said to be attracting widespread attention.

As we naturally turn to European experience, in the hope of finding that their methods may fit our conditions, this book ought to be of great assistance to investigators in this country.

The book is divided into four sections: "Insurance Against Accidents"; "Insurance Against Sickness and Death"; "Insurance Against Invalidity and Old Age" and "Unemployment Insurance." While the first section is the one now being most carefully considered in this country, it seems likely that at least two of the others will be taken up in time, if we follow the tendency abroad, as seems likely to be the case.

The book is a careful review of the work that has been done in nine European countries, giving details as to the amounts paid, the costs to employers and to employee and other information which any earnest student of the problem will find most helpful in many ways.

The Indicator Handbook, Part 1. The Indicator, Its Construction and Application. By Charles N. Pickworth. Fourth Edition, revised and enlarged. 142 5x7-inch pages, with 93 illustrations. Emmott & Co., Manchester; Whittaker & Co., London; D. Van Nostrand Company, New York. Price in England, 3 shillings; in the United States, $1.50.

The previous editions of Mr. Pickworth's excellent treatise have been duly noticed in these columns. The chief additions to the present edition relate to the various types of indicators, those shown comprising practically all recent instruments, both American and European, which have achieved any degree of prominence, including those with continuous drum action and with external springs, as well as the flashlight instruments for extremely high speeds. Of these new types there is a much greater diversity than most people are aware of, and the chapter describing them is extremely interesting and instructive. In other respects, the book is an extremely satisfactory treatise on the subject. It is accompanied by a companion volume on the analysis and calculation of the indicator diagram.

Personals*

Forrest E. Woodman has been appointed assistant engineer, Bureau of Mines, Pittsburg, Penn.

*Items for this column are solicited.

George Hanson, formerly superintendent of the Charter Gas Engine Company, of Sterling, Ill., has become president and general manager of the Havana Manufacturing Company, of Havana, Ill.

William S. Twining, formerly chief engineer of the Philadelphia Rapid Transit Company, which position he held for the past 15 years, has recently resigned in order to become engineering manager of Ford, Bacon & Davis, New York City.

R. B. Little has recently been appointed chief of the tool-designing department of the Chalmers Motor Company, Detroit, Mich. Mr. Little held a similar position at the Oldsmobile factory a few years ago, but engaged in other work in the meantime.

Robert R. Keith, who has been for the past five years mechanical engineer and general superintendent for the Light Feed Oil Pump Company, and the Richardson-Phenix Company, its successor, has resigned and is now on a Western recreation trip previous to resuming business activities.

H. J. McCaslin, who has been connected with the Wellman-Seaver-Morgan Company, Cleveland, O., for a number of years, and who may be recalled by our readers as the author of occasional articles published in our columns, has resigned in order to accept the position of instructor in pattern making at the Technical High School of Cleveland, O.

Walter Brinton, for 15 years superintendent of the manganese-steel department of the Taylor Iron and Steel Company's plant at High Bridge, N. J., has resigned to accept a position as consulting engineer for the Edgar Allen American Manganese Steel Company, of Chicago Heights, Ill., and New Castle, Del. Mr. Brinton's headquarters will be at the New Castle plant.

Charles Quast, of Winterthur, Switzerland, formerly of Chicago, and one time mechanical engineer with the Bethlehem Steel Company, and Illinois Steel Company, is in the United States for a three months' visit. He is engaged in consulting-engineering work in Europe, particularly in improving manufacturing methods and processes. While in this country he wishes to obtain information in regard to the latest developments in machine tools. His American address is 133 Salem street, Dayton, Ohio.

Obituary

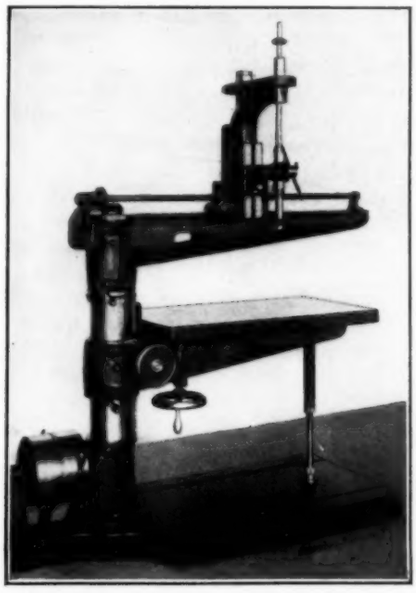
Austin K. Wheelock, vice-president of the Firth-Sterling Steel Company, and senior partner of Wheelock, Lovejoy & Co., died in Washington, D. C., on November 9. Mr. Wheelock was a prominent figure in the steel industry, with which he had been connected for nearly 40 years.

New Tools and Shop Appliances

A Light Radial Drilling Machine

The Taylor & Fenn Company, Hartford, Conn., has just brought out the light radial drilling machine, shown in the halftone.

Besides all the desirable features of their standard drill press, this machine has the advantage of greatly increased capacity. It is designed to drill holes up to ¾ inch in diameter and by applying drilling heads of different types it can be made to cover nearly all drilling requirements within its range. Automatic power feed, lever feed, high-speed sensitive or tapping heads may be used on this machine either singly or in combination. The drilling head is moved on the arm by



TAYLOR & FENN COMPANY'S LIGHT RADIAL DRILL PRESS

means of a rack and pinion. A binder on the back provides for clamping the head to the arm. The spindle has a No. 2 Morse taper hole and is positively driven by silent chain and gears. A gear box on the back of the drilling head gives three spindle speeds. The arm is of tubular section and has an exceptionally long bearing on the column supported by a ball thrust collar. The table is heavily ribbed and in addition is provided with a support for the outer end that may be used when heavy work is put on the table. Both the arm and table may be clamped to the column by binder screws, the handles of which are conveniently located. The machine is driven by tight and loose pulley and does not require a countershaft.

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.

The table is 2 inches wide by 35 inches long. Maximum distance from center of spindle to column 36 inches. Maximum distance from end of spindle to base 48 inches, to table 26 inches. Minimum distance from end of spindle to base 36 inches, to table 3¼ inches. Traverse of spindle 11 inches. Length of feed 4¼ inches. Approximate weight, 1070 pounds.

A Wheeled Crowbar

The cut shows a moving truck, or crowbar, with wheels to expedite the movement of work or material. The

A CROWBAR WITH WHEELS

bars are made with a large head which furnishes a bearing for two wheels moving independently of each other with a point in the nose of the head which grips the load.

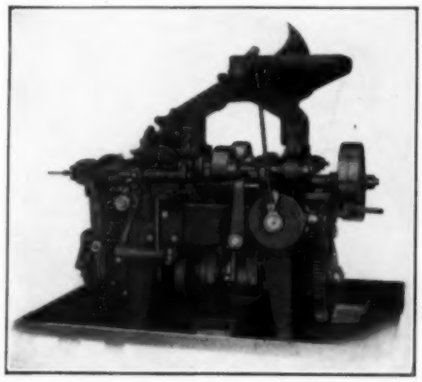
These trucks are used in sets of three, two being placed under one end of the load, the other under the opposite end, giving a bearing on three joints. By bearing down on the levers, or bars, the load is raised from the floor and is supported on the three sets of rolls, so that it can be easily moved in any desired direction.

These trucks are capable of handling expeditiously pieces weighing up to three or four tons, and are simple enough to be used by the most unskilled laborer and even in plants equipped with traveling cranes, they prove their worth by relieving the cranes of a great amount of work and accomplish results at a lower cost.

This is made by the Grover File Company, Nashua, N. H.

A Screw Shaving and Slotting Machine

The halftone shows a new machine which is being put on the market by the E. J. Manville Machine Company, of



A SCREW-SHAVING MACHINE

Waterbury, Conn. This shaver and slotter is adaptable to be used for the shaving and slotting of wood-screw and machine-screw heads, and may also be used for plain slotting operations, as required.

The principal points of advantage of this shaver and slotter are: Extreme accuracy as to the diameter of the head, the central location of the slots and the head in every case is round and true with the body. In this machine all screws up to 4 inches in length are pushed into the spindle clear to the head, no back rest being used to throw the heads out if the blanks are imperfect. The blank is held in a split chuck. The saws are mounted on a rigid bracket and can be instantly adjusted to bring the slots central with the head of the screw. The fact that the screw head is turned by being held entirely in the spindle, and that the spindles are mounted rigidly in

the frame, insures every head being round and of a very smooth finish.

These machines handle all sizes of screws from 0 to 20 gage from ¼ to 4 inches long.

The Springfield-Brandes Vertical Grinding Planer

The halftone shows the new machine which is being put on the market by the Springfield Manufacturing Company, Bridgeport, Conn. The capacity of the machine is 12 inches wide, 12 inches high and 4 feet long.

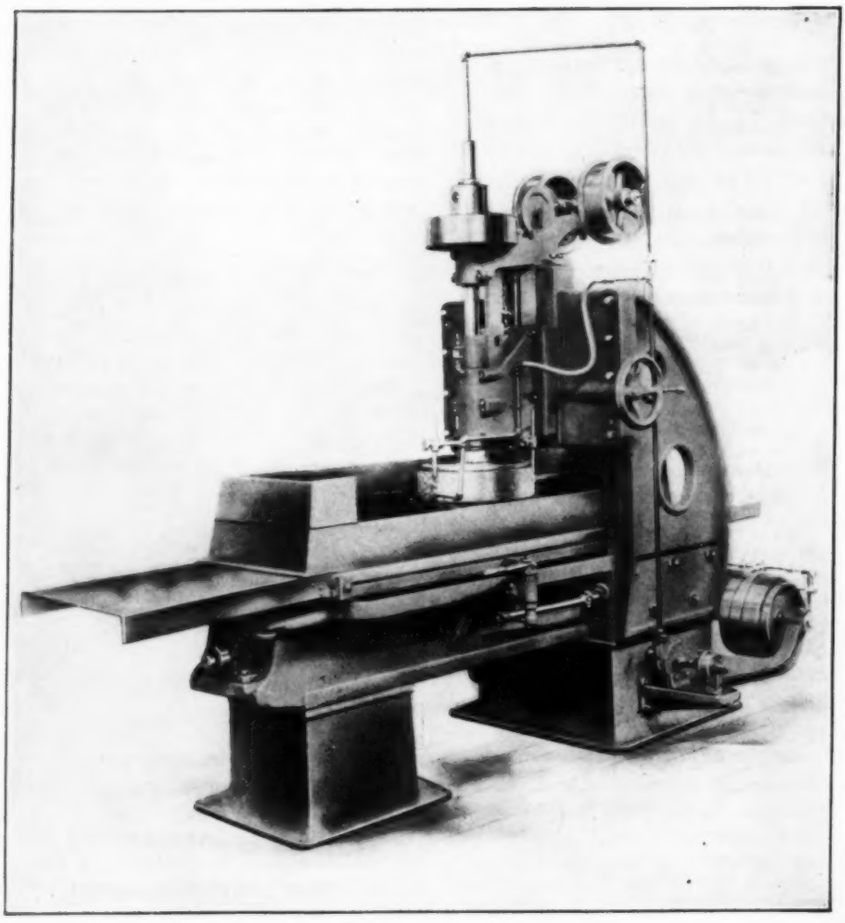
The wheel head and spindle are very heavy. The spindle is mounted in exceptionally long bearings, is provided with a ball thrust on the under side, and is equipped with a ball-bearing spring take-up on the upper part of the bearing to prevent back lash when the wheel is running off the work. The driving pulley is mounted upon an independent bearing relieving the spindle of all strain of the belt. The wheel is 16 inches in diameter, mounted in a chuck which permits of easily changing the wheels and is also well protected by guards to insure against accidents in case of damage to the wheel.

The machine has all the stiffness and rigidity of the modern planer. The guard around the table is made in sections on the front side, so as to permit of being easily removed as shown.

The table drive is through a worm and worm gear on the rear of the machine to a large screw which runs in a long nut to insure long life and smooth action.

The machine is arranged with hand feed for the wheel and equipped with a micrometer dial back of the handwheel to facilitate setting. It will also be made with a power feed when desired.

The machine is equipped with a pump to supply lubricant to the wheel which can be applied either through the spindle, or from the outside. When applied through the spindle the water is forced against a deflector so as to force the water to the periphery of the wheel.



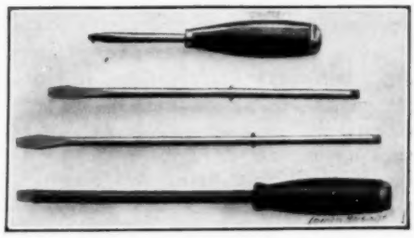
SPRINGFIELD-BRANDES VERTICAL GRINDING PLANER

The "Change Blade" Screwdriver

The halftone shows a new screwdriver which is being put on the market by Kinckiner & Scott, 626 North Twelfth street, Philadelphia, Penn.

The handle is of red brass in skeleton form, with a covering of mahogany. The blades are of tool steel with a tempered cross pin, which engages with a slot in the brass handle and takes the strain of the work. The end of the blade, which enters the handle, is threaded to fit the cap nut which retains it in position in the handle.

The blades are made in 3-, 6- and 8-inch lengths and are easily interchanged.



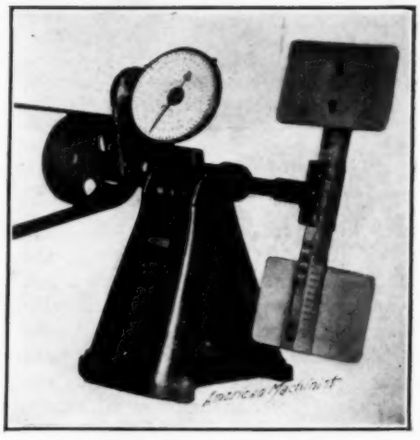
THE "CHANGE BLADE" SCREWDRIVER

The illustration at the bottom of the cut shows a change-blade screwdriver made especially for electrical work. In it the entire handle and blade are insulated with the exception of the extreme end which engages the screw slot.

A Dynamometer for Stationary Engines

The dynamometer shown in the halftone is built by Joseph Tracy, 116 West Thirty-ninth street, New York.

The dynamometer is belted direct to the engine flywheel. As the dynamometer gives the best results when driven at a speed of 800 revolutions per minute or more, its pulley should be of smaller diameter than the flywheel of a slower running engine. It is a convenient and inexpensive means for testing stationary gas and other engines developing up to 100 horsepower at relatively low speeds, and may also be used as a load to absorb the power when "running in" an engine or working down the piston and bearings. It requires neither water nor electric connections; the power delivered by the engine is spent in driving the fan against the resistance of the atmosphere, and as there is no mechanical or elec-



A DYNAMOMETER FOR STATIONARY ENGINES

trical resistance, there is no possibility of the apparatus heating up or seizing. Thus the dynamometer may be run indefinitely without attendance and horsepower and revolutions per minute readings can be taken from the dial at any time by inexpert help.

In operation, the horsepower developed, less the slight transmission loss through the belt, is indicated by the pointer on the dial of the tachometer.

The No. 3 Van Norman Duplex Milling Machine

This machine, shown in Figs. 1 and 2, is being placed on the market by the Waltham Watch Tool Company, Springfield, Mass. It embodies the same special features as their previous milling machines, viz.: a movable cutter head mounted on a ram or frame adjustable in or out over the table of the machine to adapt the cutter for use in either a vertical or horizontal position or for cutting at any angle. The features in this new machine not found in the former sizes are: A single pulley or constant-speed drive with the gear mechanism for twelve changes of spindle speeds located within the ram; gear-feed mechanism for 16 changes of feeds; an improved box type of knee; solid steel overhanging arm with tie-strap mechanism to secure rigidity under vertical or horizontal cuts.

The design is of a pleasing appearance and the machine is very solidly constructed throughout, with ample power for the spindle and feed mechanism. The details of the drive and spindle-gear change mechanism will be seen in Figs. 3 and 4. All the gears shown are of steel and those within the ram run in oil.

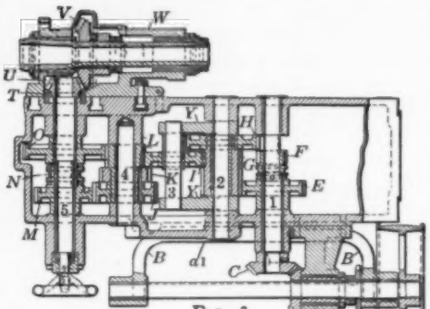


FIG. 3

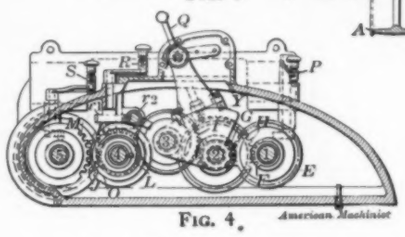


FIG. 4.

THE GEAR MECHANISM

The driving pulley *A*, Fig. 3, is 12½ inches diameter and 4¼ inches face, and with its splined shaft *a'* is supported in the bracket *B*, which is attached to the side of the column of the machine. A pair of bevel gears *C* and *D* connect with the shaft 1, within the ram and on this shaft are the loose clutch gear *E* and the combined sliding clutch and gear *F* keyed to the shaft. A lever *P*, Fig. 4, operates the clutch gear. These gears engage with the gears *G* and *H*, which are keyed together and revolve on a stationary stud or shaft 2. A swinging frame or yoke *Y* pivoted on the stud 2, and having a stud or shaft 3, carries a sliding gear *I* in mesh with the long gear *G*. A cone of gears *J*, *K* and *L*, keyed together, is supported on the stud or shaft 4. The swinging frame *Y* carrying the sliding gear *I*, has at its upper end (see Fig. 4) a spring-pin mechanism to locate it in its different positions and a locking lever *Q* to securely lock or clamp it in position. An index lever *R* with pinion r^1 engaging in the rack on a sliding fork piece r^2 locates the sliding gear *I* for suitable engagement with the cone gears *J*, *K* and *L*. Loose clutch gears *O* and *M* on the shaft 5, mesh with the cone gears *J* and *L*, and the clutch *N* is controlled by the lever *S*, Fig. 4. It will be seen that the shafts 1 and 5 revolve, while 2, 3 and 4 are studs with gears running freely on them. A handwheel on the end of the shaft 5 aids in bringing the gears in mesh when making changes. The cutter head *W* pivots on the trunnion ring *T* and the head is securely clamped in any position on the face of the ram by three locking bolts moving in circular slots. A bevel gear *U* on end of the shaft 5 and

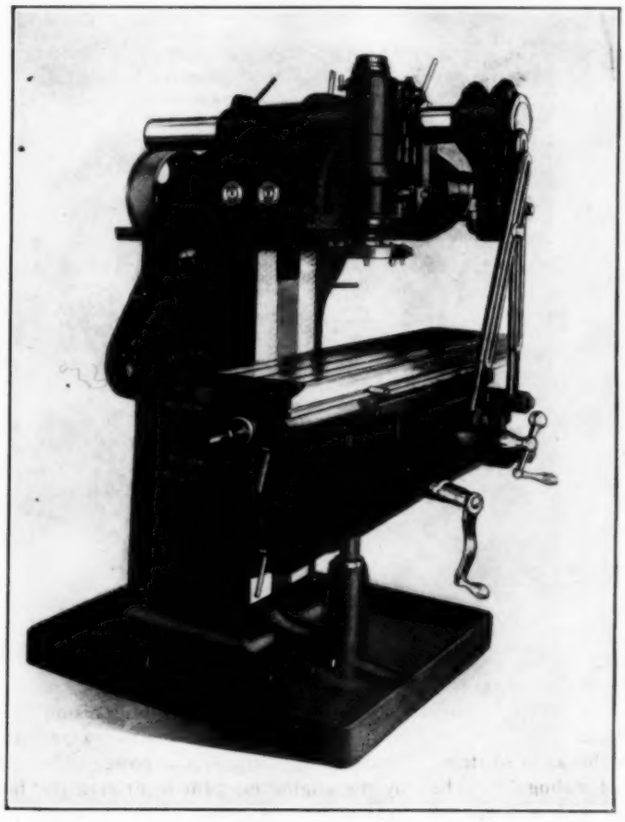


FIG. 1.

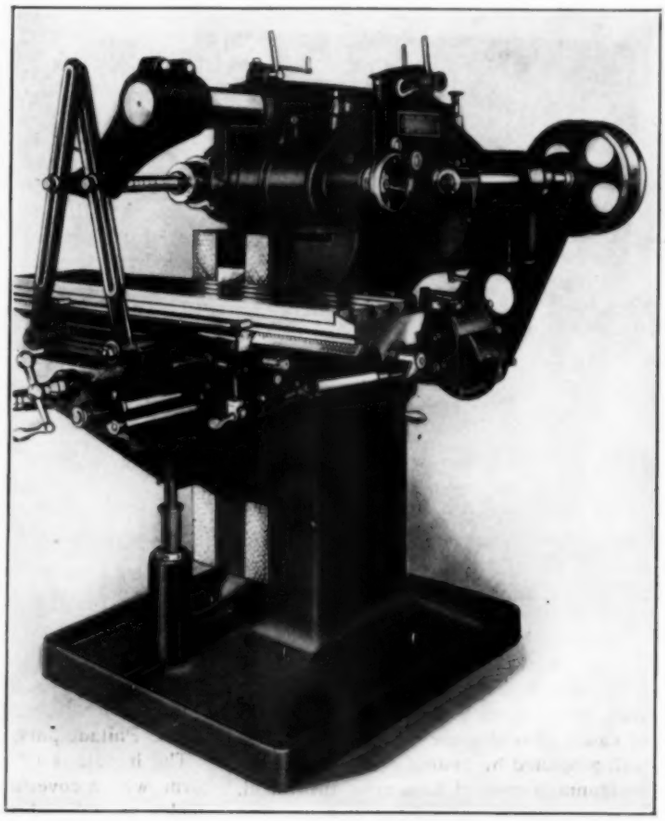


FIG. 2.

THE NO. 3 VAN NORMAN DUPLEX MILLING MACHINE

bevel gear *V* on the spindle complete the drive connection.

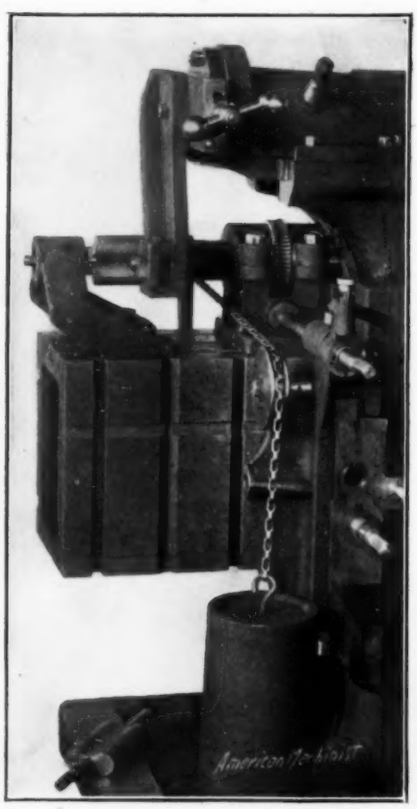
The cutter spindle has conical bearings and is made with No. 13 Brown & Sharpe taper at the mouth, to adapt it for holding the large collet holder or reducing collets as used in this machine. The ram is very securely clamped to the column after the cutter spindle is located in the most advantageous position for operation.

The general dimensions of the machine are as follows: Longitudinal feed of table, 30 inches; traverse feed, 12 inches; vertical feed, 19 inches; movement of ram or frame in and out over the column or table, 13 inches; weight of machine complete, about 4000 pounds.

A Shaper Cam Cutting Attachment

The illustration shows an attachment recently built by the Rockford Machine Tool Company, Rockford, Illinois, for one of their customers, to be used in connection with a 16-inch Rockford shaper, for automatically machining the impellers for exhausters used with vacuum cleaning machines. A finished part is shown on the base of the shaper and an impeller will also be seen in the machine set up ready for operation. The fixture consists of a head bearing, carrying a hollow spindle with work driver and masterplate on the inner end, which is of the exact form of the work to be produced. The cross-feed screw of the machine is removed leaving the saddle with work table free to move on the cross-rail slide. The master cam is held against the roller by the weight and the worm is fitted with a sliding key to the feed shaft allowing the table to move back and forth as the work rotates. The stud carrying the roller is mounted on a casting which is clamped in a fixed position to the vertical slide of the shaper column. The cutting tool used is round and of the same diameter as the roller.

This fixture has been found to be very satisfactory, finishing the impellers very rapidly and with a very high degree of accuracy. It will be seen that it can be used for machining cams or other irregular parts without sharp corners and will reproduce any shape that can be rotated against the roller.



A Shaper Cam-cutting Attachment

The Waltham Thread Milling Machine

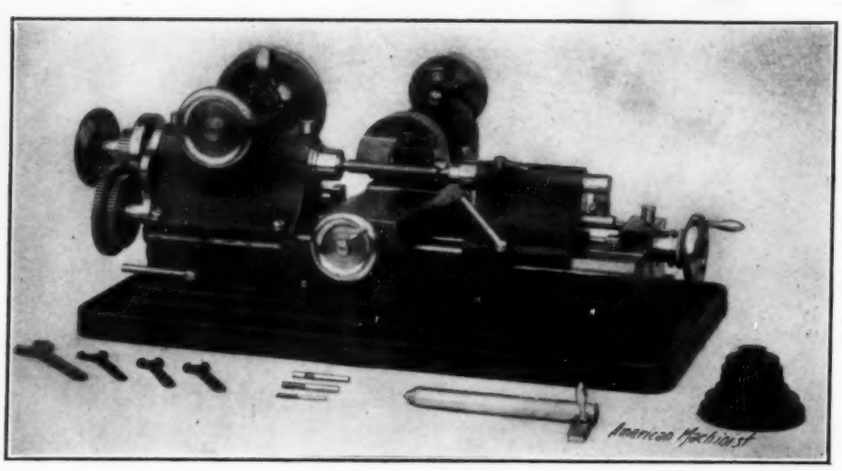
This machine, built by the Waltham Machine Works, Waltham, Mass., is intended for that class of work which is too small to be handled to advantage by the large machines now on the market, and also for that class of work where accuracy is of the greatest importance.

The cutter is 1½ inches diameter, mounted on a hardened-steel pinion driven by a train of spur and bever gears. The graduations on the vertical swivel are on an arc 4 inches in diameter and are in plain view on the top of the head.

The cross slide has a bearing 10 inches long and its screw has an index reading 0.0005 inch. The carriage has a V-bearing 12 inches long close behind the bed and a flat bearing on the front of the bed. The lead screw is in the center of the V-bearing and its center is only 3½ inches from the center of the cutter. By means of a swivel bar which can be set at an angle, the feed of the carriage, with relation to the lead screw, can be accelerated or retarded, making it possible to cut an accurate thread with a slightly inaccurate lead screw.

This feature is of great value in the milling of taps, for which the machine is especially adapted. It is a well known fact that steel alters in length in hardening. In ordinary taps this alteration is of little or no account, but where great accuracy is required the shrinkage or expansion of the steel in hardening can be readily ascertained and the device set so as to offset it.

The headstock spindle will take work, clear through, ⅝ inch diameter. The change gears furnished will cut threads from 10 to 80 per inch, but as coarse as 4 and as fine as 100 per inch can be arranged for when desired. A thread 6 inches long up to 2 inches diameter can be cut, provided the unthreaded part is small enough to enter the chuck.



The Waltham Thread-milling Machine

The Richard Oil Can

The halftone shows the construction of the bottom of the Richard solderless bottom oil can, made by the Ansonia Novelty Company, Ansonia, Conn.

The can is made of cold-rolled steel and the bottom is curled in as shown, no cement, solder or brazing being used. It is claimed that rough usage, such as throwing the can on the floor, will not cause this can to leak.

The Richard Oil Can

A Portable Arbor Press Stand

The Cleveland Machine Speciality Company, Cleveland, Ohio, has placed on the market the portable stand suitable for their Numbers 5 and 6 arbor presses, as shown in the half tone.

The stand is of box construction, open in the back. Ribs inside of the column permit three shelves for holding arbors, collars, broaches and other special fixtures used on the machine and which it may be desirable to keep with the machine when it is moved about.

The stand has a depth of throat of 10 inches.

The pot for receiving the arbors as they drop from the work, has a lead-lined bottom to prevent injury to arbors and is removable from the base.

This stand is also made without the truck and used as a stationary stand.

PORTABLE ARBOR PRESS STAND

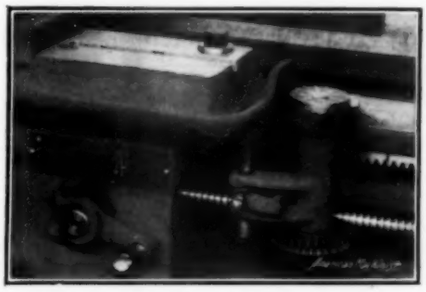
Net weight of the portable stand is 450 pounds and with No. 5 press as shown, 800 pounds. Floor space 24x41 inches.

The Lodge & Shipley Thread Indicator

The Lodge & Shipley Machine Tool Company, Cincinnati, Ohio, is now furnishing a thread indicator as part of the regular equipment of every lathe. As shown in the illustration, this thread indicator, which is attached to the right of the front arm of the carriage, has several novel features.

The worm wheel of the indicator is held lightly against the lead screw by a coil spring and can be swung back from engagement when desired. Or, if a quantity of work which requires no threading is to be machined, the whole attachment can be quickly removed.

Attached to the front of the apron close to the thread indicator is a brass instruction plate, reading as follows: "Directions—For all even threads, close half-nut at any line on the dial; for all odd threads, close half-nut at any numbered line; ½ threads any ¼ revolution; ¼ threads any ½ revolution." Thus all necessary instructions for using the attachment, briefly stated, are continually before the operator.



THE LODGE & SHIPLEY THREAD INDICATOR

The B. H. Rotary Cleaner

This device, manufactured by the Brown Hoisting Machinery Company, Cleveland, Ohio, is intended for the removal of scale and rust from structural shapes, plates, etc.

It consists of two circular plates on the same hub supporting at their perimeters a series of pins on which are carried steel blades or cutters. These blades are rectangular in shape and the hole on which they are supported on the pin is elongated, so that in revolving they have a maximum efficiency. This tool is used on a high-speed pneumatic or electric grinder.

Its effectiveness is obtained by the chipping blows of the blades removing scale and rust from the work.

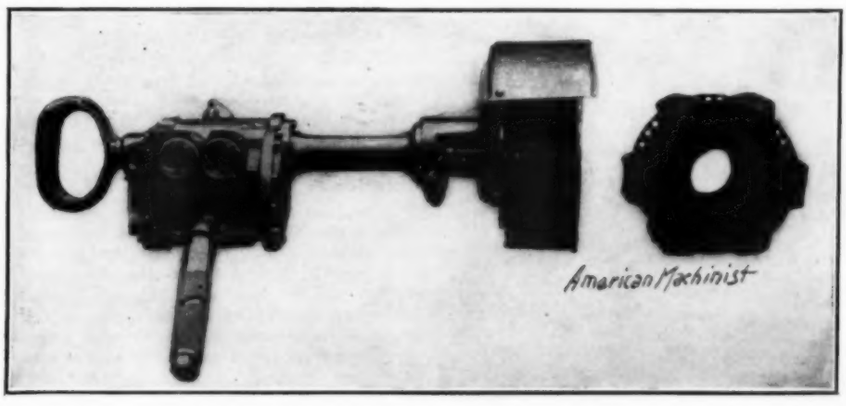
It is simple in design; has interchangeable parts and is free from jar.

One man with a B. H. rotary cleaner can do the work of several men with scrapers or brushes and get better results.

The Problem of Research

The future of the American university is with the graduate school or department of research. It is by the enlargement of human knowledge that progress in civilization and improvements in the life and condition of mankind are rendered possible. The scientific investigator who discovers new laws of nature does more for the relief, assistance, and uplifting of his fellow men than all the politicians who deafen the world's ears with their panaceas—too often, alas, mere sounding brass and tinkling cymbals. And the infallible lessons of human experience for thousands of years—does not the scholar by patient research spell them out and write them down for our instruction? These two—the scientist with his fruitful experiments, the scholar with his productive research—are the seers and accredited leaders of mankind in this Twentieth century. In their light we shall see light, otherwise we walk in darkness. And it is such scientists and scholars who constitute the research department of the university.

Here is the multi-millionaire's opportunity for the greatest and best investment in America! By means of a large endowment for research (say, $20,000,000, which might be given at once or spread over ten or twelve years) he would make it possible for at least one American university to enter upon the highest stage of university life and activity and to discharge its supreme functions to the American public and human civilization. A university dedicated by such an endowment to advanced work and research would challenge comparison with the best European universities and set an example which would prove contagious among the other leading universities of the United States.—*Extract from annual report of President Schurman, of Cornell University.*



THE B. H. ROTARY CLEANER ATTACHED TO PNEUMATIC GRINDER

Increasing Shop Capacities

METAL WORKING

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

NEW ENGLAND

Yahing & Cohoon, Bristol, Conn., brass founders, will erect a new plant.

The Springfield (Mass.) Foundry Company will move to Old Orchard, Mass.

Genther & Stevens, 113 Haverhill street, Boston, are in the market for automatic screw machine.

The Farrell Foundry and Machine Company, Ansonia, Conn., is making additions to its rolling-mill plant.

The Carver Cotton Gin Company, East Bridgewater, Mass., is building an addition to its machine shop.

The United Shoe Machinery Company, Beverly, Mass., is making an addition to be used for manufacturing purposes.

The Waterbury Farrel Foundry and Machine Company, Waterbury, Conn., is contemplating the erection of an additional machine-shop building.

New machine shop is being erected for the Thomas Laughlin Company, on Hancock street, Portland, Me. This will be equipped with uptodate machinery for manufacturing marine hardware.

The Hess Manufacturing Company, Boston, Mass., has been incorporated for the purpose of manufacturing laundry machinery. Capital, $100,000. Incorporators, Franklin P. Hess, W. F. Smith, J. C. Smith, A. W. Whitey.

MIDDLE STATES

The Detroit Steel Products Company will build a forge shop.

The Ohio Brass Company, Barberton, Ohio, is building an addition.

The Buick Motor Company, Flint, Mich., will erect a drop-forge shop.

The West Allis Iron Works, West Allis, Wis., will erect a new foundry.

The Sangamo Electric Company, Springfield, Ill., is building an addition.

The Taubig Auto Company will erect a $15,000 garage at Eau Claire, Wis.

The Buhl Malleable Company expect to erect a steel foundry at Detroit, Mich.

The Central Railroad of New Jersey is rebuilding its roundhouse at Ashley, Penn.

The Downington (Penn.) Manufacturing Company will erect a new pattern house.

The Stevens Iron Works and Fire Proofing Company, Cleveland, Ohio, is building a plant.

The General Foundry Company, Bradford, Penn., will erect a foundry at Warren, Ohio.

The Northern Machine Company, Milwaukee, Wis., will have a new two-story shop built.

The Kelker Blowing and Forging Company, Elt street, Buffalo, N. Y., will enlarge its plant.

The Racine Boat Company, Racine, Wis., has plans for a new machine shop and power plant.

The Standard Oil Company is building a car-repair shop at its Atlas Works, Buffalo, N. Y.

The Pittsburg Coal Company, Pittsburg, Penn., is considering plans for a machine and forge shop.

The James Foundry Company, Clyde, Ohio, will build a new plant. New equipment will be required.

Geo. H. Brenner, Portage, Wis., will open a repair shop in connection with his automobile business.

The Independent Electric Company, Inc., Milwaukee, Wis., will soon be in the market for machine tools.

The Detroit (Mich.) Forging Company has awarded contract for the construction of a new shop building.

The Lorraine Motor Company, Philadelphia, Penn., will erect a garage at Thirty-seventh and Ludlow streets.

The Day Automobile Company, Detroit, Mich., will build and equip a factory for the manufacture of automobiles.

The James S. Taylor Company, Bloomfield, N. J., which manufactures hardware, will move to Poughkeepsie, N. Y.

The Southern Railroad has commenced to rebuild its burned shops, at Princton, Ind. New machinery will be installed.

The Schacht Motor Car Company, of Cincinnati, has begun work on a new factory 500x70 feet, and three stories high.

The Century Steel and Iron Company, Buffalo, N. Y., is erecting an addition for the manufacture of bessemer-steel castings.

The S. G. Taylor Chain Company, Chicago, Ill., has purchased site at Hammond, Ind., on which a new plant will be erected.

M. W. Jamieson & Co., Warren, Penn., pump manufacturers, are enlarging their plant and are in the market for machinery.

Fire destroyed the molding department at the plant of Stanley G. Flagg & Co., Pottstown, Penn., causing a loss of about $10,000.

Johnson Brothers Company, Terre Haute, Ind., expects to be in the market for machinery for the manufacture of gasolene motors.

The blacksmith and carpenter shops of the Pennsylvania Coal and Coke Company, at Ehrenfeld, Penn., were burned. Loss, $10,000.

The Michigan Alkali Company, Alpina, Mich., is erecting an addition to be used as a machine shop, blacksmith shop and storeroom.

The Eynon-Evans Manufacturing Company, Philadelphia, Penn., is considering the installation of new furnaces in its brass foundry.

The Syracuse (N. Y.) Safe Company has purchased the Phœnix foundry, at East Water and Orange streets and will enlarge the buildings.

The Smalley Manufacturing Company, Manitowoc, Wis., is erecting a two-story machine shop. The company manufactures farm machinery.

The Newaygo Engineering Company, Newaygo, Mich., is to erect a new factory in the spring for the manufacture of its ore separators, etc.

The Packard Motor Car Company, Philadelphia, Penn., is asking for bids for the construction of a large garage on Broad street, near Pearl.

The Bennett Axle and Transmission Company, Detroit, Mich., is to erect a factory for the manufacture of transmission gears and automobile accessories.

The Marine Boiler Works, Toledo, Ohio, will erect an addition to its plant and will engage in the manufacture of other boilers besides the marine type.

The New York Central Iron Company, Geneva, N. Y., is looking for a site for a plant for the manufacture of furnaces for steam and water-heating plants.

The American Automobile Company, Louisville, Ky., will install machine-tool equipment for the manufacture of motor cars at its plant at New Albany, Ind.

The Preston Company, Drexel building, is erecting a foundry at Bridgeton, N. J., and is in the market for a 900-horsepower engine and 1200-horsepower boiler.

The Lake Shore Railroad is planning an addition of a machine shop at Collinswood, Ohio. It is also in the market for motors for the shops at Elkhart, Ind.

The Pittsburg Steel Company has authorized the appropriation of $5,000,000 for additions to its plant at Monessen, Penn. Four blast furnaces will be installed.

Forsyth Brothers Company, Chicago, Ill., manufacturing railway specialties, has purchased site and is planning the erection of a plant to employ about 1200 men.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids December 13, for one 30-inch planing machine as per Schedule No. 3052.

The Milwaukee Electrical Rialway and Light Company will build a large machine shop and Fortieth street and Cold Spring avenue, Milwaukee, to cost $20,000.

The National Metallic Bed Company, 320 East Ninty-fifth street, New York, is seeking site in the New England section for a new plant and furnace for melting iron.

The Bowling Green Garage Company, Bowling Green, Ohio, has been incorporated with $10,000 to operate a garage and repair shop by A. E. Royce, R. E. Bates, Robert Place, etc.

The Coin Machine Manufacturing Company, Portland, Ore., has purchased site at Trafford City, Penn., on which it proposes to erect a plant which will employ about 2500 men.

The Jackson Church Company, Saginaw, Mich., will erect a new plant at Saginaw, to consist of a pattern and machine shop, foundry and boiler house. Electric drive will be used.

The Noll Pump Company, New York, has been incorporated to manufacture pumps, machinery, etc. Capital, $100,000. Incorporators, E. Delmar, G. V. Maynard, J. J. McGuire.

The Star Pointer Pump and Sprayer Company, Chicago, Ill., has been organized to manufacture pumps, etc. Capital, $45,000. Incorporators, G. G. Willard, W. H. Willard, J. Cook.

The Henry Motor Sales Company, Chicago, Ill., has been incorporated to manufacture automobiles, etc. Capital, $25,000. Incorpor-

ators, A. E. Dumang, C. F. Latimer, J. J. Maloney.

The Hessler Foundry and Manufacturing Company, Oswego, N. Y., has been incorporated with $50,000 capital. Incorporators, G. J. Hessler, E. A. Hessler, C. W. Hessler, Syracuse.

Chicago Combination Lock Company, Chicago, Ill., has been incorporated to manufacture locks, etc. Capital, $25,000. Incorporators, P. W. Chapman, J. W. Donaldson, T. Chapman.

The Gotham Can Company, now located on Cliff street, New York, has purchased a factory building at 72 Eagle street, Greenpoint, and will move to that place after alterations are made.

The Townsley-Comstock Motor Company, Chicago, Ill., has been incorporated to manufacture automobiles. Capital, $25,000. Incorporators, L. E. Townsley, S. E. Comstock, E. F. Comstock.

Meyer & Gross, Newark, N. J., have incorporated with $100,000 capital to manufacture jewelry. Incorporators. J. H. Meyer, G. Lewis, Newark; A. J. Gross, R. Gross, Kansas City, Mo.

Brown-Saulter Motor Truck Company, Newark, N. J., has been incorporated to manufacture automobiles, auto trucks, etc. Capital, $100,000. Incorporators, J. E. Brown, G. Saulter, H. Saulter.

The Smokeless Furnace and Stove Company, Chicago, Ill., has been organized with $25,000 capital to manufacture stoves, furnaces, etc. Incorporators, J. I. Hughes, J. C. Green, C. B. Munday.

The Frey Auto Supply Company, Buffalo, N. Y., has been organized to operate garage, deal in automobiles and accessories. Capital, $25,000. Incorporators, J. W. Frey, A. Karl, J. A. Donaldson.

Norwalk Drilling Tool Company, Norwalk, Ohio, has been incorporated with $30,000 to operate a general machine and tool shop. Incorporators, Edgar G. Martin, E. A. Boughton, G. P. Hogan, etc.

The Standard Automatic Machine Company, New York, has been organized with $50,000 capital to manufacture and deal in machinery. Incorporators, Louis Sachs, B. H. Levy, Chas. J. White, 2 Rector street.

The Jewelers and Silversmiths Company, New York, has been organized for the purpose of manufacturing jewelry and silverware. Capital, $50,000. Incorporators, H. H. Galinger, T. K. Wheeler, E. Galinger.

Victor Motor Truck Company, Buffalo, N. Y., has been incorporated to manufacture and deal in motor vehicles, engines, etc. Capital, $250,000. Incorporators, H. B. Clark, O. L. Neal, B. E. Need, etc.

The Oakley Foundry and Engineering Com- New York, has incorporated to manufacture and deal in machinery. Capital, $10,000. Incorporators, Jas. G. Gregg, J. T. McGovern, C. W. Gormly, 141 Broadway.

The Maximilian Machine and Tool Company, Buffalo, N. Y., will erect a factory at Woodstock, Ont., for the manufacture of pneumatic tools. Lathes, milling machines, drills, grinders, presses, etc., will be required.

The Handy Press Company, Grand Rapids, Mich., has been organized to manufacture and deal in machinery for baling waste paper. Capital, $37,550. Incorporators, Wm. A. Brummeler, A. J. Brummeler, R. J. Brummeler.

Cincinnati Machinery Company, Cincinnati, Ohio, has been organized to manufacture and sell laundry and dry-cleaning machinery, etc. Incorporators, H. Williams, John W. Daley, Charles Follett, etc. Capital, $30,000.

The Morrow Manufacturing Company, of Wellston, Ohio, has purchased a factory building near its plant, which will be remodeled into a large addition. Considerable machinery will be installed. The concern is also erecting a foundry building.

The Jewel Carriage Company, of Carthage, Ohio, filed papers with the Secretary of State increasing its authorized capital from $250,000 to $450,000. Increased facilities for the manufacture of automobiles and horse-drawn vehicles are desired.

Perfect Fireless and Electric Cooker Company, Toledo, Ohio, has been incorporated with $50,000 to manufacture and sell electrical cooking apparatus. Luther D. Smith, William A. Humphrey, Charles F. Nighswonger, and others, incorporators.

The Lackawanna Manufacturing Company, Newburgh, N .Y., manufacturing gasolene motors and connected with the Coldwell Lawn Mower Company, lost most of its plant by fire, but a new plant has just been completed for which equipment is being purchased.

The Western Machine Company, Eau Claire, Wis., is being incorporated with P. J. Holm, formerly of Sparta, Mich., as president and manager, for the purpose of manufacturing gas engines. Is now located in temporary quarters, but will erect plant in the spring.

Niger Auto Pump Company, Buffalo, N. Y., has been incorporated to manufacture, deal in and repair automobiles, trucks, motor boats, pumps, etc. Capital, $10,000. Incorporators, Frank T Niger, 616 Walnut street, Niagara Falls; Philip H. Stern, 388 Main street, Buffalo, etc.

Suspension Roller Bearing Company, Sandusky, Ohio, has been incorporated to manufacture and sell roller bearings and general machine equipment. ncorporators, E. A. Boyer, W. W. Neighbour, E. W. Neighbour, E. Neighbour and Fred Coy. Capital, $250,000.

The Utility Car Company, of Buffalo, N. Y., has recently incorporated with a capital of $1,000,000, and is endeavoring to secure a location in the Central West for the manufacture of the Auto-Tri-Package car. Chas. E. Locke, 27 William street, New York, is treasurer.

The International Automobile and Engine Company was incorporated at Dover, Del., with $10,000,000 capital to manufacture airships, motor cycles, motor boats. Incorporators, W. D. Yarnall, Yeadon, Penn.; E. H. James, Sharon Hill, Penn.; S. C. Seymour, Camden, N. J.

The Sommer Motor Company, Bucyrus, Ohio, was incorporated to manufacture and sell automobiles, motor trucks and motor boats and do a general machine business. Incorporators, L. A. Sommer, L. M. Smith. F. C. Hopley, S. S. White and D. F. Flohn. Capital, $125,000.

The Elite Novelty Company, New York, has been incorporated to make metal goods and metal ware. Capital, $10,000. Incorporators, Jack Katz, 226 West One Hundred and Thirteenth street; Alfred Pioneer, 35 West One Hundred and Sixteenth street, New York; Albert Blumlein, 437 Pacific street, Brooklyn.

The Pontiac (Mich.) Motocycle Company, organized with $600,000 capital, is erecting a plant to consist of three buildings for the manufacture of motorcycles. Plant will be equipped for electric drive. Following equipment is needed: Polishing and plating devices; oil-burning furnaces, suitable for steel treatment; oil-brazing stands; portable enameling ovens and small uptodate tool equipment, suitable for this line of manufacture. Robert W. Brownson is president and general manager.

The Pontiac Drop Forge Company, Pontiac, Mich., capitalized at $100,000, is erecting a plant for the manufacture of small drop forgings, and is in the market for the following equipment: Steam drop and helve hammers, from 100 to 2500 pounds; shears, trimming and stamping presses; oil-burning furnaces for forging and heat-treating blowers; hammers; oil tanks and complete die-shop equipment, suitable for this class of manufacture. Robert W. Brownson is president and general manager.

SOUTHERN STATES

The Lenoir Car Works, Lenoir, Tenn., is adding to its equipment.

T. E. Matthews & Brothers' foundry, at Martinsburg, W. Va., was destroyed by fire.

The Fairmount & Clarksburg Traction Company will erect repair shops at Fairmount, W. Va.

The Winton Motor Car Comapny, Baltimore, Md., will erect a large garage at Maryland and Mount Royal avenues.

The Parker Cattle Guard Company, of New Orleans, La., and Birmingham, Ala., will establish a plant at New Orleans for the manufacture of cattle guards. Headquarters are in the Whitney Bank building, New Orleans.

WEST OF THE MISSISSIPPI

The Hawkeye Pump Company, Fairfield, Iowa, is erecting a new factory.

John Stork, manufacturing a patent screen, is erecting a factory at San Diego, Cal.

Henry Brown, of Chippewa Falls, Wis., will build machine shop and blacksmith shop.

The Southern Pacific Railroad will erect a 20-stall roundhouse at Klamath Falls, Ore.

S. J. Anderson, of Gayville, S. D., will erect a blacksmith shop with engine room.

Toms & Blair, San Diego, Cal., manufacturers of a patent hinge, are erecting a factory.

The Grandjean Gas Machine Company, San Diego, Cal., contemplate the erection of a factory.

The Field Automobile Company, 245 North Ninth street, Lincoln, Neb., will erect a two-story factory.

The Portland (Ore.) Railway, Light and Power Company is negotiating for a site for new car shops.

F. A. Nelson, Portland, Ore., will erect a factory for the manufacture of a patent street-car fender.

J. D. Morgan, Fresno, Cal., will erect a commercial garage. Modern repair machinery will be installed.

John Westover, Inc., Lincoln, Neb., operating structural steel works, will erect foundry and other buildings.

Edwards & Bliss, Holtville, Cal., are erecting a commercial garage. Modern repair equipment will be installed.

The Denver, Laramie & Northwestern Railroad is building machine shops and roundhouse at Utah Junction, Colo.

The Parker Iron Works, San Bernardino, Cal., will double the capacity of its plant. The company does a general machine-shop business.

The Davis Expansion Boring Tool Company, St. Louis, Mo., has reorganized. New plant will be erected for which equipment will be needed.

The Swanson Manufacturing Company, Shenandoah, Ia., manufacturing plows, harrows, etc., is said to be considering the removal of its plant.

The Hastings (Neb.) Foundry and Iron Works has under consideration the erection of five buildings, including foundry, machine and carpenter shop, etc.

The Odell Manufacturing Company, Los Angeles, Cal., manufacture of cutlery, sharpening machines, etc., will erect a factory at Lawrence and Hunter streets.

The Kansas Auto Wheel Company, 601 New Hampshire street, Lawrence, Kan., a new concern, has plans under way for a factory for the manufacture of a new wheel.

The Lone Star Iron Works, Dallas, Tex., has been incorporated with $100,000 capital by B. Kinsell, J. H. Leiber, W. S. Myers, etc., to manufacture structural iron work and do a general foundry business.

The Toombs Roller Bearing Wheel Company, St. Louis, Mo., has been incorporated with $50,000 capital to manufacture roller-bearing wheels. Incorporators, I. M. Toombs, B. S. Adams, W. A. Toombs, etc.

CANADA

H. Trumbull is building a large automobile factory at Windsor, Ont.

The Schwab Boiler Heating Company will locate a plant at Ottawa.

The Canadian Autopress Company, Toronto, Ont., is increasing its plant.

The Ottawa Furnace Manuafcturing Company will locate a branch at Calgary.

The Cummings Brass, Iron and Wire Company will build a factory at Winnipeg.

The Winckley Brass Manufacturing Company will erect a plant at Windsor, Ont.

The Grand Trunk Railway will equip new shops in connection with the roundhouse at Windsor, Ont.

Part of the plant of the Wilkinson Plow Works, at Toronto, destroyed by fire, will be rebuilt at once.

The Elder Carriage Works, of Toronto, is building a large plant for the manufacture of automobiles.

The Steel Radiation, Ltd., with headquarters in Toronto, Ont., has purchased site at Montreal where a plant for the manufacture of boilers and radiators will be erected.

General Manufacturing

NEW ENGLAND

The North Dana (Mass.) box shop was destroyed by fire.

Wagstaff, Ltd., Hamilton, Ont., canners, will enlarge plant.

G. C. Haywood, Hingham, Mass., will purchase a power edger.

The waterworks committee, of Willis, Mass., will buy hydrants and valves.

The Berkshire Street Railway will erect a substation at Cheshire, Mass.

The Cabot Manufacturing Company, of Topsham, Me., will install a boiler.

The Hampden Glazed Paper Company, Holyoke, Mass., is enlarging its plant.

The Bay State Mop Company, Woburn, Mass., is in the market for a band saw.

The Parsons Steam Laundry, New Bedford, Mass., is building a new boiler house.

The Electric Manufacturing Company is to erect a factory at Pittsfield, Mass.

The Ruggles Machine Company, Poultney, Vt., is in the market for a gas engine.

W. H. Wilder, Gardner, Mass., is seeking site for a modern woodworking plant.

The Massachusetts Cotton Mills, Lowell, Mass., will install an hydro-electric plant.

H. A. Leigh, 20 Hadley place, Medford, Mass., is in the market for electric motors.

The Aspinook Company, Jewett City, Conn., is in the market for pumps and condensers.

The St. Croix Paper Company, Woodland, Me., is in the market for sawmill equipment.

The Woonsocket Comb Company is to enlarge its plant and install new machinery.

H. Y. Heywood Company, Franklin, Mass., is erecting an addition to be used as a dryer.

The Dennison Tag Manufacturing Company is to open a new plant at Southbridge, Mass.

The grain elevator of Loring & Co., Watertown, Mass., was destroyed by fire. Will be rebuilt.

The Easton Machine Company, South Easton, Mass., is in the market for a boiler and engine.

The York Manufacturing Company, Saco, Me., is purchasing equipment for a new power house.

The O. C. White Company, Worcester, Mass., is in the market for a 125-horsepower Corliss engine.

The Hersey Manufacturing Company, of South Boston, Mass., is making an addition to its factory.

Robert D. Mason Company, Pawtucket, R. I., is making additions to the dyeing and finishing room.

The Ramapogue Ice Company, West Springfield, Mass., is to have an ice conveyer, 580 feet long, erected.

The E. P. Reed Company, North Abington, Mass., is building a coal pocket and will require conveying machinery.

The Hawkins Basket Manufacturing plant, at Milford, N. H., is nearing completion. New machinery will be installed.

The Wee Laddie Farm, Charlton Depot, Mass., is in the market for a 10- or 12-horsepower portable steam boiler.

The Metropolitan Water and Sewerage Board, Boston, Mass., will erect an hydro-electric plant at Clinton, Mass.

The Burlington Traction Company, Vergennes, Vt., will install two hydro-electric units of 1000 horsepower each.

MIDDLE STATES

Marion, Ind., will erect a new electric-lighting plant.

The Milwaukee (Wis.) Chair Company will erect a three-story addition.

The Bell Smokeless Powder Company will build a plant at Vincennes, Ohio.

The Ohio Canners' Association will establish a branch factory at Dayton, O.

The Mutual Chemical Company, Jersey City, N. J., will erect a new plant.

The United States Gypsum Company is erecting another mill at Oakfield, N. Y.

The Flexible Wheel Company, Bound Brook, N. J., will erect a larger plant.

The Onondaga Bed Company, Water street, Syracuse, N. Y., is enlarging its plant.

George Norgaard, of La Crosse, Wis., is promoting the erection of a soap factory.

W. K. Herron, 9312 Kinsman road, Cleveland, Ohio, will erect a new boiler house.

The Roach & Seeker Company will erect a refrigerating plant at Ironwood, Mich.

The Western Electric Company, of Chicago, will establish a branch at Buffalo, N. Y.

The Bedell Furniture Company, of Marion, Ind., will erect a plant in Muskogee, Mich.

The Buffalo (N. Y.) Box Company will erect a $14,000 factory at 10 Scoville street.

The plant of the East Jersey Pipe Works, Paterson, N. J., was partly destroyed by fire.

The Thomas Coaster Toy Company, of Sheboygan, Wis., will erect a three-story addition.

The N. J. Rich Knitting Company, Cleveland, Ohio, has commenced work on a new factory.

The Bos-Bolhins Lumber Company, Holland, Mich., is in the market for additional equipment.

The Edgar Veneer and Manufacturing Company, of Edgar, Wis., will erect a $30,000 plant there.

Fire destroyed the cold-storage plant of the Newport (N. Y.) Warehousing Company. Loss, $120,000.

The Ohio Varnish Company will erect a new factory at 8705 Kinsman road, S. E., Cleveland, Ohio.

The Erie Railroad is in the market for coal-handling machinery for its docks at Cleveland, Ohio.

The Hannibal (N. Y.) Electric Company has secured a franchise to erect an electric distributing plant.

Oscar Knipe & Co., Orwigsburg, Penn., is building a new paper-box factory to be operated by electricity.

The council proposes to install 225 additional horsepower at the city light and water plant, Menasha, Wis.

George Pagel's box factory at 1339-1345 West Twenty-first street, Chicago, Ill., was burned. Loss, $10,000.

The Alleghany Valley Brick Company is in the market for machinery and equipment for its plant at Olean, N. Y.

The Wisconsin Auto Top Company will need new machinery and electric motors for its factory at Milwaukee..

The Cleveland (Ohio) Electric Illuminating Company will erect a $250,000 power plant on East Seventy-sixth street.

The Lawrence Clay Products Company, Canton, Ohio, will soon erect a plant for the manufacture of building brick.

The National Woolen Company, Cleveland, Ohio, will erect a new factory building at 3150 West Thirty-second street.

The Snider Packing Company, Cincinnati, Ohio, has been looking for a suitable location on which to erect a new plant.

The Muhlenberg Hospital, Plainfield, N. J., will increase the capacity of its power plant. New engine, etc., will be installed.

The exhauster house and engine rooms of the Public Service Gas Supply Company, Paterson, N. J., destroyed by an explosion.

The Phœnix Knitting Company, Milwaukee, Wis., will have erected an $85,000 factory building at Broadway and Chicago streets.

Matthew Lamont Company, Bay City, Mich., will build a new concrete factory. Power and woodworking machinery will be needed.

The Plainfield Union Water Company, Netherwood, N. J., will increase the capacity of its plant. Will install new pumps and boiler.

The Herancourt Brewing Company, Cincinnati, Ohio, will erect a $40,000 building to be used as a cold-storage plant and stock house.

The Cascade Chair Company, St. Regis Falls, N. Y., has broken ground for a pulp mill and will also erect a factory for the manufacture of butter tubs.

The Lakeside Paper Company, Menasha, Wis., was organized to manufacture lightweight specialties. Capital, $125,000. Incorporators, J. L. Fleweger, W. C. Nash, L. T. Jourdain.

The America Monoservice Company has purchased the building of the Woodside Tanning Company, Newark, N. J., which will be equipped for the manufacture of a paper receptacle for liquids.

The Isthmian Canal Commission, Washington, D. C., will receive bids until 10:30 a.m.,

December 5, for dredge buckets, spring wire, rail benders, valves, cocks, pipe fittings, hinges, rules, etc., as per Circular No. 612.

The W. F. Goltha Tie Company, Cleveland, Ohio, has been organized with $10,000 to manufacture and sell railroad ties and other timber products. Incorporators, W. F. Goltha, L. C. Mainbourg, P. J. Gallagher, etc.

John J. Stump, of Akron, Ohio, is looking for a suitable site at Martel, Marion county, Ohio, for the location of a plant to manufacture automobile bodies. A company has been organized recently of which J. E. Bending is president; P. S. Cressinger, secretary and treasurer, and John J. Stump, general manager.

Proposals will be received at the office of constructing quartermaster, Fort Leavenworth, Kan., until 11 a.m., December 5, for one 40- to 45-ton standard gage locomotive, two standard gage air brake and air dump cars, two standard gage flat cars. Information can be had of Capt. J. E. Normoyle, quartermaster.

SOUTHERN STATES

The Knoxville (Tenn.) Woolen Mills will make extensive improvements.

The Standard Knitting Mills, Knoxville, Tenn., is making extensive additions to its plant.

J. C. Roulette & Sons, proprietors of the R. A. Knitting Mills, Hagerstown, Md., will erect a large plant at Waynesboro.

The Baldwin Forging and Tool Company, of Columbus, Ohio, is preparing to build a plant at Richmond, Va., for the manufacture of shovel handles.

The Lexington (Ky.) Interurban and Street Railway Company is preparing plans for a new $300,000 power house to take the place of the present one.

WEST OF THE MISSISSIPPI

J. H. Bailey, of Peever, S. D., will build a feed mill.

Kryn Verhuel, of Le Mars, Iowa, will erect an ice plant.

The town of Wasco, Cal., will install a complete water system.

A sawmill will be installed at the Cooney mine, Mongollon, N. M.

Woodhull & Linger, of Beach, N. D., will erect a binding-twine plant.

O. C. Gould & Son will erect a cement factory at Fairmont, Minn.

The San Ysidore Colony, San Diego, Cal., will build a canning factory.

The trunk factory of Kehoe & Filbert, Los Angeles, Cal., was damaged by fire.

The Enterprise Lumber Company's mill, at Godfrey, Wash., was destroyed by fire.

The Potosi Brewing Company, of Dubuque, Iowa, will erect a plant at East Dubuque.

The Aberdeen Hide and Tanning Company, of Aberdeen, S. D., will erect a tannery.

W. E. Allen, San Diego, Cal., furniture manufacturer, is erecting a factory building.

The city of Chinook, Mont., is contemplating the erection of a municipal lighting plant.

F. F. Roby, of Kearney, Neb., is considering doubling the capacity of the artificial ice plant.

Frank Moore, of Little Falls, Minn., will erect a refrigerator and butter-storage plant there.

The Chicago, Milwaukee & St. Paul Railroad will erect a power house at Tacoma, Wash.

The Heron Lake (Minn.) Brick and Tile Company will make extensive additions and improvements.

The plant of the Lone Star Milling and Grain Company, Prosper, Tex., was burned. Loss, $75,000.

The Tustin Hills Packing Company, Tustin (near Santa Ana), Cal., will erect a packing house.

The Nauman Company, of Waterloo, Iowa, will erect a sash and door factory next year. Cost, $125,000.

The Des Moines (Iowa) Electric Company plans to spend $7000 in rebuilding the old portion of its plant.

The Henry Hess Brick Company's plant at St. Augusta, Minn., will be doubled to meet the increased demand.

The Nicholai Door and Manufacturing Company, Portland, Ore., is in the market for factory equipment.

John Wessman, Porterville, Cal., will erect a mill and storage building. Modern equipment will be installed.

Gregory & Langford, of Redlands, Cal., will erect a packing house and fertilizer factory on the Santa Fe tracks.

The Portland Railway, Light and Power Company, Portland, Ore., will erect a 15,000-horsepower power plant.

The St. Paul (Minn.) Tannery Company is to erect a four-story addition to be equipped with modern machinery.

Bishop & Co., cracker manufacturers, Los Angeles, Cal., contemplate the erection of a factory at San Diego, Cal.

The Durostone Company of America, manufacturer of building material, is erecting a plant at Chula Vista, Cal.

W. C. Greene, Santa Cruz valley (near Tuscon, Ariz.), contemplates extensive work in irrigation improvements.

The North Star Mines Company, Grass Valley, Cal., contemplates installing a large engine at the Central mine.

B. A. Chisholm, of Meadows, Idaho, contemplates the erection of a power plant for lighting, at Hermiston, Ore.

The Vinton (Iowa) Canning Company will erect a three-story addition. New 100-horsepower engine to be installed.

The Potrero Heights Land and Water Company, Whittier, Cal., will erect a large pump house and pumping station.

The Minneapolis (Minn.) Gas Light Company will erect a one-story boiler house and a three-story generating plant.

The Corona Foothill Land Company, Corona, Cal., will install a new pumping apparatus for its irrigation system.

T. J. Nixson and others, of Stella, Neb., have applied for a franchise to install electric-light plant at Highmore, S. D.

The Imperial Union High School, Imperial, Cal., will install a pumping and sewerage system. Bids are now being asked.

The board of trade, at Tulare, Cal., can furnish information regarding a fruit cannery to be erected there to cost $16,000.

The Hume Fishing and Canning Company, La Playa (near San Diego), Cal., contemplates enlarging its factory in the near future.

The American Liquid Fire Roofing Company, of Mason City, Iowa, will erect a modern factory and equip with new machinery.

W. E. Allen, furniture manufacturer, of St. Louis, Mo., has purchased a site at San Diego, Cal., and will erect a furniture factory.

The Harbor City Land Company, Long Beach, Cal., contemplates the erection of a hotel. Power-plant equipment will be required.

James Irvine and associates, Santa Ana, Cal., will build a sugar factory in this vicinity to cost $600,000. Equipment will be required.

The Pacific Vegetable Packing Company, Smeltzer, Cal., is erecting a packing house at Bolsa, Cal. Modern equipment will be installed.

The plant of the Casselton (N. D.) Electric Light Company has been purchased by Lloyd Lunch and Chester Hallett, who will put it in repair.

The H. Raphael Company, manufacturer of sash and doors, Los Angeles, Cal., contemplate the erection of a factory at San Diego, Cal.

The Southwestern Sugar and Land Company, Glendale, Ariz., contemplate the erection of a beet-sugar plant in Imperial valley, to cost $1,000,000.

Emil Firth, Los Angeles, Cal., will install a complete system of irrigation in his 4000-acre tract of the Perris Valley Land and Water Company ranch.

A modern warehouse to cost $100,000 will be erected at Albuquerque, N. M., by the Chas. Ilfield Company, of Albuquerque. Equipment will be required.

The Imperial Creamery, Imperial, Cal., will make extensive alterations in its plant. A refrigerating plant, cream ripeners and churns will be installed.

The Manhattan Mining Company, operating in the Comobabi mountains (vicinity of Tucson, Ariz.) is making extensive alterations and improvements in its plant.

The Builders' Supply Company, 937 San Fernando street, Los Angeles, Cal., is building a warehouse addition to its plant to cost $5000. Modern equipment will be installed.

The Upland Heights Water Company, San Bernardino, Cal., has been incorporated for $75,000. The company will operate in the Upland Irrigation district, and plans extensive improvements.

The Los Angeles Gas and Electric Company, Los Angeles, Cal., will build an extensive addition to its plant, increasing its capacity by 6,000,000 cubic feet of gas. Cost, about $85,000.

Dr. A. G. Schloesser, Los Angeles, Cal., and associates, will erect a hotel at Hollywood, Cal., to cost in the neighborhood of $1,000,000. Power-plant machinery and equipment will be required.

Power-plant equipment will be required in the new hotel to be erected at Nuvida Springs (near San Diego, Cal., by Senator DuPont and associates. Harrison Albright, architect, Los Angeles, Cal.

Power-plant machinery and equipment will be required in the new department-store building to be erected in San Diego, Cal., by George W. Marston, of the Marston store. Plans are now being prepared.

Equipment will be required in the new polytechnic high school to be erected at Ventura, Cal. Seventy-five thousand dollars will be expended upon this structure. N. F. Marsh, architect, Los Angeles, Cal.

The Nevada Salt and Borax Company, of Fallon, Nev., has been incorporated for $1,000,000. It will develop th esalt marshes in Carson Sink, Nev. The company has plants at Jersey City, N. J., and Santa Bar-Barbara, Cal.

Power-plant equipment, steam-heating apparatus, refrigerating system and ventilating machinery will be required in the new hotel at El Paso, Tex., to be erected by the El Paso Hotel Company. Bliss & Faville, architects, San Francisco, Cal.

CANADA

Dunville, Ont., will equip a hydro-electric station.

Mitchell, Ont., will equip a hydro-electric power station.

Trail, B. C., will install a complete new waterworks system.

Sherbrooke, Que., will spend large sums to develop water power.

Barber & Johnson will erect a packing plant at Guelph, Ont.

Mansonville, Que., will install a new modern waterworks system.

Point Grey, B. C., will spend $250,000 on new waterworks extensions.

Calgary, Alberta, will install a $50,000 incinerator with blast furnaces.

Fredericton, N. B., will make important additions to its waterworks plant.

The Stewart Bottling Company is building a large new factory at Montreal.

F. C. Durant will locate an immense sugar-refining plant at St. John, N. B.

The city of Winnipeg will install an extensive plant for water softening.

The plant of the Peerless Brick and Tile Company, at Ottawa, will be doubled.

The Monarch Knitting Company is building a large new factory at St. Thomas, Ont.

The Moose Jaw Pressed Brick Company is erecting a $100,000 plant a Moosejaw, Sask.

The Edward Partington Company will build a large paper mill at St. Johns, N. B.

The Moose Mountain Mining Company will erect a very large refining plant at Sellwood, Ont.

The mill of Joseph Clark, at Mount Brydges, Ont., destroyed by fire, will be rebuilt.

The Peoples Railway Company, of Berlin, will buy large quantities of machinery and equipment.

The Central Heat, Light and Power Company, of Montreal, is building a new plant in Montreal.

The large planing mill of J. E. Cutler, at Welland, was destroyed by fire. Will be rebuilt at once.

The British Columbia Electric Railway Company, of Vancouver, will buy $500,000 of new equipment.

The city of Winnipeg will buy one 10-ton hand-operated traveling crane and one 15-ton hand-operated traveling crane.

The International Electrical Company, of Nelson, B. C., will spend large sums developing electrical power in various parts of British Columbia.

MINING

The Nevada Wonder mine, at Wonder, Nev., will erect a 100-ton mill.

The Helen Mining Company, Graham, N. M., is making extensive improvements in its plant.

A modern cyanide plant is contemplated at the Mammoth mine, Goldfield (near Mesa), Ariz.

The Cassidy mine, Grass Valley, Cal., is making extensive improvements in its equipment.

The Inspiration Copper Company, Globe, Ariz., will install a 5000-ton concentrator at its plant.

The Precious Metals Mining Company, Goldfield, Nev., is making improvements in its plant.

The Sierra Madre mine, Chihuahua, Mex., contemplate the erection of a modern milling plant.

G. H. Bradford, Tonopah, Cal., is installing a ten-ton mill at his mine, Chrysopolis, Inyo county, Cal.

The Yellowpine mine, at Goodsprings, Nev., will install a modern concentrator and separator plant.

The El Favor Mining Company, Aguascalientes, Mex., will add two new tube mills to its plant.

The Deadwood mines, at Mongollon, New Mexico, is making extensive improvements in its plant.

The Miradora Mining Company, Aguascalientes, Mexico, will erect a 100-ton plant some time in 1911.

The Antelope Valley Gold Mining Company, Los Angeles, Cal., will install a 100-ton mill at its Rosamond mine.

The Altar District, Sonora, Mexico, will install a 500-ton dry placer concentrating plant. Plans are now being drawn.

The Mexican Onyx Company, operating at Oaxaca City, Mexico, is making extensive improvements in its plant.

The Pacific Copper Company, Silver Mountains (near Prescott), Ariz., is making extensive improvements in its plant.

A mill and other machinery will be installed at the mines of the Ft. Bidwell Consolidated Mines Company, Mountain View mine, Alturas, Cal.

The Cochise Mining and Milling Company, Johnson, Ariz., contemplates the erection of a mill on its property. The main office of the company is at Marion, Ind.

Lewis Bradbury, of the Bradbury interests, Los Angeles, Cal., contemplates extensive improvements in the company's silver mine in the Bolonas district, Jalisco, Mex.

The American Smelting and Refining Company will make improvements in smelter at El Paso, Texas, to cost $250,000. Reverberatory furnaces, converters, etc., will be installed.

Ben Daniels, Tucson, Ariz., owner of a group of mines in the Santa Rita mountains, worked by the Elephant Head Mining and Milling Company, will soon be in the market for an aërial tramway.

The Young Construction Company, Los Angeles, Cal., has the contract for the erection of two gyratory crushers and one jaw crusher at the Porphyry Rock Quarry, Corona. Additional machinery and electrical apparatus will be required.

BUSINESS ITEM

Pawling & Harnischfeger Company, Milwaukee, Wis., has opened a branch office in the Washington building, Portland, Ore. R. K. Morse, manager.

TRADE CATALOGS

Matson Machine and Tool Company, Bethel, Vt. Circular. Bethel safety cutting-off machine. Illustrated.

The Abbott Ball Company, Hartford, Conn. Catalog. Steel-ball tumbling barrel. Illustrated, 12 pages, 3½x6½ inches, paper.

Allis-Chalmers Company, Milwaukee, Wis. Bulletin No. 4025. Compressed Air for Industrial Purposes. Illustrated, 3x6 inches.

Raymond Manufacturing Company, Ltd., Corry, Penn. Catalog. Springs and wire specialties. Illustrated, 24 pages, 5x7 inches, paper.

Dodge Manufacturing Company, Mishawaka, Ind. Booklet. "Five and One Half Miles per Minute." Dodge iron-spider wood-rim pulley. Illustrated, 3½x6½ inches.

C. U. Scott, Davenport, Iowa. Catalog. Annealing, hardening, tempering furnaces, high-speed steel furnaces, pressure blowers, gas forges, etc. Illustrated, 30 pages, 4½x8 inches, paper.

FORTHCOMING MEETINGS

American Society of Mechanical Engineers, annual meeting, December 6-9, New York. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

American Foundrymen's Association, annual convention, Pittsburg, Penn., May 23 to 26, 1911. Richard Moldenke, secretary, Watchung, N. J.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. S. Clark, secretary, 141 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

Philadelphia Foundrymen's Association; meetings first Wednesday of each month, Manufacturers Club, Philadelphia, Penn. Howard Evans, secretary, Pier 45 North, Philadelphia, Penn.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care, 505 Pearl street, New York, will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

MISCELLANEOUS WANTS

Caliper catalog free. E.G.Smith, Columbia, Pa.

Special machinery and tools designed and detailed. Box 146, AMERICAN MACHINIST.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

The "Gas Saver" brazing forge; circular. J. L. Lucas & Son, 2 Fox St., Bridgeport, Ct.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Tool designing, mechanical and electrical drawings. Berkshire Engineering Co., Pittsfield, Mass.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents, C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Wanted—Spur gear cutter to take 8-foot gears; state condition fully and where can be seen. Dillon-Box Iron Works Co., Denver, Colo.

The Nassau Company, 828 Broad street, Newark, N. J., coöperative purchasing department, invite catalogs, price and discount lists, machinery, tools and supplies.

Large English firm of machine tool importers having showrooms and offices in Great Britain, France, Germany, Italy, India and Japan is wanting good agencies for machine tools of all kinds. Box 189, AMER. MACH.

Nutter & Barnes Company, Boston, Mass., have one of the best equipped machine shops and solicit lathe, planer, milling machine, turret lathe, drill, gas engine or automobile machine parts work, by day or contract.

A well equipped machine shop and foundry desires to add to its line of manufacture either by consolidating with another similar company, or by purchasing or manufacturing on royalty some articles of iron or steel which have ready sale. Address "Machine Shop," AMERICAN MACHINIST.

HELP WANTED

Classification indicates present address of advertiser, nothing else.

CANADA

Diemakers Wanted—Two or three experienced diemakers; those accustomed to work on trunk hardware preferred. Box 206, AM. M.

ILLINOIS

Wanted—Experienced machinist capable doing pattern work; also assistant. Fetzer & Co., Springfield, Ill.

Wanted—Superintendent for hardware specialty plant; must understand manufacturing, able to make estimates and be a producer; the right man will be given an interest if desired. Box 194, AMERICAN MACHINIST.

Wanted—Man who has had large experience and understands fully repair parts end of large mechanical manufacturing plant; no one need apply who is not thoroughly competent; good opportunity for a good man. Ernst Tietgens, 218 West Superior Street, Chicago, Ill.

INDIANA

Superintendent, to take complete charge of a plant employing 400 men and manufacturing a varied line of special machinery; must have experience in machine shop, sheet metal, pattern and foundry work; a splendid opportunity for a high grade, uptodate man, having executive ability; state fully experience and age in first letter Box 173, AMER. MACH.

MASSACHUSETTS

Head draftsman and designer, experienced on rotary printing presses and folders. Box 132, AMERICAN MACHINIST.

Wanted—Instrument maker and all-around machinist for physical laboratory; must be familiar with all sorts of work, tool and patternmaking, German or Swiss preferred; good place and chance to learn; moderate wages. Write, stating experience and wages to Prof. A. G. Webster, Clark University, Worcester, Mass.

MICHIGAN

Toolmaker Wanted—Man thoroughly familiar with heat-treatment of high speed tools, including reamers, milling cutters, etc. Give age and full details of experience and wages expected. Box 197, AMERICAN MACHINIST.

Wanted—First class toolmaker who has had experience in making tools for trunk and suit case locks and hardware; also press room foreman, who understands setting up tools and running presses. Box 160, AM. MACH.

NEW YORK

Salesman, having acquaintance with trade to represent large textile belt manufacturer; high class producer only wanted. "Results," AMERICAN MACHINIST.

Boiler fuel economy; agent required in the United States for the sale of scientific instrument selling freely and in successful operation in Europe and British Colonies; price each, about $200. Box 175, AMER. MACH.

Wanted—Practical man as superintendent or foreman and invest few thousand; established company, well equipped small factory; too much business present capital; open fullest investigation. Box 205, AMER. MACH.

OHIO

Foreman wanted on erecting floor in locomotive works; state age, experience and address. Box 208, AMERICAN MACHINIST.

Wanted—First-class machinists, toolmakers, die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

RHODE ISLAND

Wanted—Experienced man to take charge of automatic screw machine department; must be familiar with Cleveland and other makes. Box 190, AMERICAN MACHINIST.

WISCONSIN

Expert tool designer, having shop experience as well as technical training in pressed steel work to take charge of tool drafting room for large stamping plant in Milwaukee; unusual opportunity for an ambitious and capable man; state salary and past experience. Box 166, AMERICAN MACHINIST.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

ALABAMA

An experienced and practical machine tool salesman, technically educated, would like to correspond with manufacturer or large dealer, who is prepared to liberally compensate a man, who can deliver the goods. Box 198, AMERICAN MACHINIST.

CALIFORNIA

In West, Middle or Southwest, position requiring a high grade man with brains, initiative, ability and experience; salary secondary consideration; engineering, mining or manufacturing. Box 159, AMERICAN MACHINIST.

DELAWARE

Position as assistant manager or superintendent in manufacturing company; age 32; technical graduate; broad experience in uptodate methods, factory management, precision machinery, sales and advertising; excellent references. Box 179, AMERICAN MACHINIST.

General foreman and chief draftsman desire a change in present positions; have been working together for the past five years in leading machine tool concern; broad experience in designing and manufacturing of high speed machine tools; excellent credentials. Box 211, AMERICAN MACHINIST.

MASSACHUSETTS

Assistant superintendent or general foreman; A-1 tool and machine designer; can get maximum output from equipment; age 34. Box 174, AMERICAN MACHINIST.

Superintendent; age 38; first class executive and highly successful manager of men; practical mechanic; now employed; highest references. Box 125, AMERICAN MACHINIST.

General foreman, 30 years of age, desires change; expert mechanic and manager; uptodate methods of toolmaking and manufacturing; thoroughly posted on piece work system; now employed as foreman in one of the most successful and uptodate machine shops in New England; best references. Box 204, AMERICAN MACHINIST.

NEW JERSEY

Chief draftsman desires change; strictly up to date; will consider a similar position or superintendent, assistant superintendent or general shop foreman. Box 187, AM. MACH.

NEW YORK

Draftsman, expert, tools and special machinery, desires change, preferably in New York City. Box 189, AMERICAN MACHINIST.

Draftsman, special machine and tool designer, interchangeable parts; 10 years' experience; location immaterial. Box 207, AMERICAN MACHINIST.

Foreman or superintendent; 20 years' experience; excellent record; hustler; expert on dies and automatic machinery. Box 202, AMERICAN MACHINIST.

Draftsman and machinist, experienced on special and automatic machinery, experimental work, etc., desires work during spare time. Box 195, AMERICAN MACHINIST.

Any firm wishing to make their own die molded castings can obtain the services of a man who is thoroughly posted by addressing Box 155, AMERICAN MACHINIST.

Graduate mechanical engineer, experienced designer and chief draftsman, 28, now employed, desires position offering a future. Box 200, AMERICAN MACHINIST.

Designing mechanical engineer, experienced on tools and machine tools for manufacturing of valves and fittings, desires to change. Box 209, AMERICAN MACHINIST.

Foreman, 34, now engaged; medium or heavy work; thoroughly conversant with piece work and uptodate methods; electrical or general machinery; references from present employer. Box 203, AMER. MACHINIST.

Mechanical engineer, European, 32 years old, 10 years' experience as draftsman and superintendent of motor and automobile works, good jigman and hustler, desires position; A-1 references and speaks four languages; will go anywhere. Box 190, AMER. MACHINIST.

Situation Wanted — Mechanical engineer, with executive ability and practical experience that will meet the most exacting requirements in uptodate designing and manufacturing of tools and machinery to increase production. Box 201, AMERICAN MACHINIST.

Engineer, 32 years old, graduate of a German technical college, 10 years' practical experience, steam engine pumps, tools and mill weighing, used to control of men of different nationalities, possessor of several languages, desires appointment as superintendent or head foreman. Box 188, AMER. MACHINIST.

Superintendent, high-class man; can crowd the work out, meet competition in highly competitive lines; close at rating, estimating; thoroughly practical at tools, dies, machinery; any line of manufacturing; never failed to surpass all expectations in making good my representations. Address "Mechanical Engineer," 91 Sixth Ave., Brooklyn, N. Y.

OHIO

As production engineer; tools, equipment, time setting; technical graduate; 12 years' experience. Box 183, AMERICAN MACHINIST.

PENNSYLVANIA

An A-1 designer wishes change. Box 184, AMERICAN MACHINIST.

Draftsman, experienced on gas engines and producers up to 200 horsepower. Box 177, AMERICAN MACHINIST.

Cost accountant, 10 years in machine shops and foundries, desires to change; references. Box 162, AMERICAN MACHINIST.

General foreman is open for a position as superintendent or general foreman; 32 years old, with good education; 12 years of experience as tool and diemaker on all kinds of tools and dies and manufacturing systems in the gun, adding machine and electrical line; guarantee to get results; correspondence to be mutually confidential. Box 120, AMERICAN MACHINIST.

WISCONSIN

Foreman of drafting and tool room, die and jig designer; expert on designing and making dies for automobile stampings, executive ability; American; 38. Box 123, AM. M.

A superintendent or shop manager is open for engagement; thirty years' experience manufacturing sheet metal and wire goods, hardware and special machines; particularly strong in developing, fitting up for and in manufacturing new devices, and in systematizing, cutting down costs and increasing production. Box 192, AMER. MACHINIST.

FOR SALE

Wanted to sell fair size machine shop; am building small gas engines and do a general repair business; will sell whole or part. R. J. Schlosser, Warren, Penn.

For Sale—One patent and one patent pending on heavy machine tools; no competition, some in operation; will sell for cash, or part cash, balance as royalty. Box 193, AM. MA.

For Sale—A 250-horsepower McEwen direct connected engine and dynamo; engine is 18x18; dynamo 150 kilowatts, 250 volts, 600 amperes; can be seen running; price, $2500. Send for details to J. L. Lucas & Son, 3 Fox street, Bridgeport, Conn.

For Sale or Exchange—Cleveland automatic screw machine ⅜"-½", with very complete equipment; little used; would exchange for other tools, such as 6-spindle drill press and disk grinder. Durbrow & Hearne Mfg. Co., 12 Wooster St., New York.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

Talks With Our Readers

By the Sales Manager

After the catalog, what?

What does a prospective buyer get after he has written a manufacturer for information and receives a catalog?

Oftentimes the catalog doesn't hit exactly the right spot and the buyer waits for further information to be sent—and too often waits in vain.

So much has been written and said about the importance of having good informative copy in advertising that some think it is the whole thing in a selling campaign.

Advertising by itself doesn't make sales, as a rule.

When it does in the machine-making field it's accidental.

A good business can be increased by advertising just as surely as our chest measurements can be increased by exercising — advertising alone won't do it.

We can build up our bodies by exercise, but not if we neglect diet, sleep, fresh air and other essentials.

Just as exercise is one of the factors in body-building, so advertising is in business-building.

The other factors are good follow-up, salesmen, etc.

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When we do get follow-up letters they are more than likely to be long-winded, pointless, written to answer all cases and don't answer any, printed in one shade of ink and filled in with another, sent out without any system, each piece pulling in a different direction without any cumulative force whatever.

* * *

We are all selfish.

We don't care a tinker's hurrah about "We are doing this?" "We are improving that?" etc.

The vital point to us in any advertising matter is what benefit there is in the proposition for us.

We're not particularly interested in any talk about the firm—except what it can do for us—dollars and cents talk.

When we write to a manufacturer, we want information.

This need not be written in sentences and paragraphs that buzz and hum like an emery wheel, sputtering fire, or crackle and flash like a trolley wire on a sleety night.

All we want is a salesman-like presentation of a definite bona fide advantage to us of buying.

Until its salesman arrives, a catalog, and the matter that follows, is the representative of the concern that sends it.

More and more firms realize that advertising in your paper is only one member, although one of the most important, in a selling campaign.

That it uncovers new prospects, wins the interest and confidence of buyers, keeps the old customers in line, makes the salesman's approach far easier and his arguments more effective.

Their follow-up matter is written from the buyer's standpoint, gives information so that one piece supplements the other and it would be a good thing for the buyer if every manufacturer bore this in mind.

Just so fast as the advertising and the follow-up matter improve—all the links in the distributing chain made stronger—

Will its efficiency increase—

And buying made easier.

* * *

Only reliable products can be continuously advertised.